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REDIGIT

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Tisza-Research Working

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DR. LÁSZLÓ GALLÉ, SR.

(1908—1980)

He was born in Zenta, a small town of Bácska (the southern part of the region between the Danube and the Tisza rivers in Jugoslavia), where he also finished his middle-school studies. He began his university studies in Beograd but graduated in Szeged. After taking his teacher's degree, specialized in biology and chemistry, till 1936, he worked in the Institute of General Botany in the University in Szeged.

From 1937, he was teacher, later on head master of a grammar school in Szeged. Still later, his task was not only the immediate guidance of the Miklós Radnóti grammar school in Szeged but his name is connected with the reorganization of this into a normal grammar school (attached to teachers' training college), as well. Some of his research fellows became later headmasters, senior lecturers and readers, and even professors of a University or College.

Parallel with his activity, he was also active as school-inspector and headed committees at secondary-school final examinations. In the 50's, he also organized the village particles of the Peasant Workers' Middle Schools, in conformity with the commission of the Ministry of Education. In addition to his headmaster's and other school-work, he was also active in the Society for the Dissemination of Knowledge, where he delivered several scientific lectures for the general public.

Apart from his biological and popular educational work he followed up his scientific work, as well. His activity included the domains of lichenology and teratology. He actively participated in the work of the Tisza-Research Working Committee, too. He rendered account of his results in lectures and publications. The number of his botanical papers published exceeds eighty. His collection, containing more than ten thousand bags, was placed in the Ferenc Móra Museum in Szeged where, after retiring in 1970, he worked as a research worker till his death.

In 1978, after defending his candidate's thesis, written from the domain of plant teratology, in a public debate, he was granted a candidate's degree in biological sciences.

Memberships : He was a member of the international British Lichen Society in London, of the Szeged Division of the Biological Society of the Hungarian Academy of Sciences (and even a secretary of this for some years), of the Tisza-Research Working Committee, of the Society for the Dissemination of Knowledge. He was a member of the editorial board of the publication TISCIA and of the yearbook of the Ferenc Móra Museum.

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DR. GY. BODROGKÖZY

ZOLTÁN JÓSA

(1914—1980)

He left our circle unexpectedly, 66 years old, leaving after himself an irrecoverable loss as a protistologist, as a leading worker of the scientific instruction and, last but not least, as an indefatigable biologist teacher.

He was born on 21 June 1914, in Pancsova. His parents were teachers, as well: his father and grandfather were teachers of biology. In the University in Szeged, he obtained the university leaving certificate in 1936, as a teacher trainee, specialized in natural history-geography. Beginning from this, he acquired the methods of the protistological research as a research assistant in the renowned Gelei-school, with special regard to the physiology of cell, the ion-effects. His successfully career was broken by World War II. Later on, he played a prominent part in the renewal of the Society of Natural Sciences, as the county-secretary of the Society for the Dissemination of Knowledge.

He began dealing rather extensively with scientific research work after 1957. He joined in the work of the Tisza-Research Working Company, as well. (Hydrobiological investigation into the sodic waters of the Great Hungarian Plain, the protozoan fauna, alimentation-, resp. saprobiology of rice-fields, the Ciliata plankton of the Tisza, faunistical, eco-, microbio-, coenological investigations, etc.). His papers have appeared in the yearbooks of the Teachers' Training College (Szeged) and later in the TISCIA.

The principal trend of his educational activity was the research into the fundamental and methodological problems of the biological instruction. As a methodologist, he delivered more than one lecture of national level at home (Nyíregyháza) and abroad (1956: Potsdam, 1969: Dresden, Rostock, Nitra). Through many years, he participated in making and reviewing various curricula of studies. In a schoolbook-competition, he won a second prize, as well. The subjects of his research were, among others, to establish the quantity of biological concepts and the depth of their contents, to work out their types experimentally, to investigate into their educational effectivity within the framework of the subject „Living world". His papers relating to these subjects (cca 40), from various spheres of themes (creation of biological ideas and concepts in education, logical and educo-psychological analysis of the biological lesson, role of differentiation, education to evolutionistic approach, etc.), were published in the Methodological Publications. As a reader in the college, he conducted

the activity of the scientific study circle of the Department with great ambition and sence of responsibility. He applied the means of the up-to-date educational technique with success, introduced new methodological investigations (tape recorder, slide synchronizer) into teaching biology.

He deceased in the midst of his work, plans on 1 June 1980. His memory will be treasured by his devotees, colleagues, pupils.

DR. GY. CSONGOR

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HEAVY-METAL INVESTIGATION INTO THE WATER- AND BOTTOM-SEDIMENT SAMPLES OF THE RIVER TISZA

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Water Conservancy of the Lower Tisza Region
(Received 12 November, 1979)

Abstract

The authors determined in Hungary, for the first time, the heavy-metal content of the water and silt of the Tisza along the entire longitudinal section of the river.

Introduction

Among the environment-conservation problems of our days the heavy metals polluting the surface waters come more and more into question. These matters, foreign from the surroundings, mean a great danger because they dont't become harmless in a natural way, inhibit the decomposition of the organic polluting materials, and even they can poison the vegetable and animal kingdom of the living water, as well (KERTAI 1976).

The heavy-metal loading of natural waters is composed of two fundamental factors: the background pollution of geological origin and that of industry and agriculture, which is "foreign from nature". The knowledge of background pollution would be important for investigating into the possible extraordinary pollution, its establishment is, however, a difficult task.

The biological response given to the metals, which got into the water environment, is determined by whether there is present in the water some legandum responding to the water and whether the metal is present in a solution or in the form of colloidal particles.

According to Mancy, the existence of the following forms in water is to be taken into cosideration (MANCY 1972):

Soluble forms:

(a) free hydrated ions
(b) metal complexes formed with inorganic ($^{=}OH$, $CO_3^{2=}$, etc.) and organic ligands (amines, proteins, humic acids, etc.)

Insoluble particles:

(a) aggregates of colloidal metal complexes or hydrated metal oxides
(b) metal complexes, adsorbed on suspended particles.

Both outward forms of heavy metals may be observed both in water phase and in the bottom-sediments of surface waters.

The origin of the heavy-metal pollution, the way of its getting into the living water can be extremely multifarious as depending on the kind of heavy metal.

The main sources of the mercury pollution are: the chloroalkali electrolysis, paper-manufacturing, caustics.

Cadmium comes mainly from galvanization, chemical catalytic processes, metallurgical technologies.

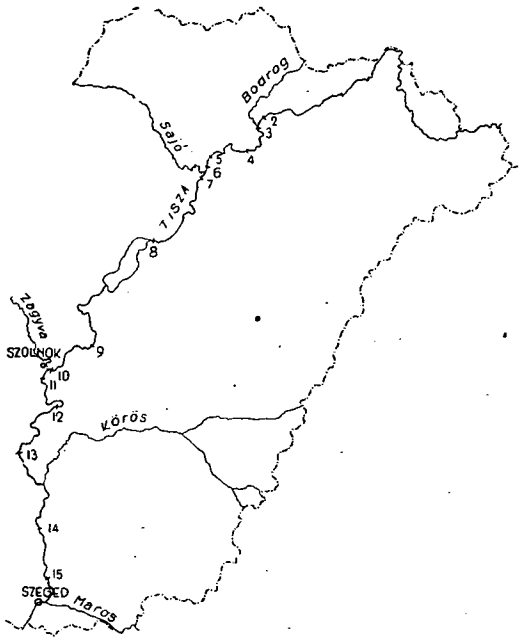

Fig. 1. Numbers used: 1=the Tisza at Dombrád 2=the Tisza above the mouth of the Bodrog 3=the Tisza at Tokaj 4=the Tisza at Tiszalök 5=the Tisza at riv. km 446 6=the Tisza at Leninváros, above the mouth of the Sajó 7=the Tisza at Leninváros, below the mouth of the Sajó 8=the Tisza at riv. km 399 9=the Tisza at Nagykörü 10=the Tisza at Szolnok, above the mouth of the Zagyva 11=the Tisza at Szolnok, below the mouth of the Zagyva 12=the Tisza at Martfü 13=the Tisza at riv. km 268 14=the Tisza at riv. km 213 15=the Tisza at riv. km 199.

A large share of the lead pollution originates from the knock reducers used in petrol. The corrosion of paints, lead-containing things also play some role.

The primary sources of chrome are: metallurgy and galvanic industry. Zinc comes from metallurgy, galvanic and chemical industries, corrosion of structural matters and various metal things.

The main causes of copper pollution are: corrosion of copper-containing things, galvanizing, dye-works, the use of copper-containing pesticides.

The permissible concentration values of the most important metal polluters are summarized in Table 1 (P. LITHERÁTY 1977).

In our investigations, from among the above-mentioned heavy-metals, the investigation of the following was carried out: mercury, lead, cadmium, total chrome, copper, and zink.

Table 1. *The concentrations of the most important metal-polluters, permissible in surface waters, in mg/l*

Metal pollution	COMECON recommendation, 1963 Class of water quality		
	I	II	III
Toxic:			
mercury	0.005	0.01	0.02
cadmium	0.005	0.03	0.2
lead	0.1	0.1	0.1
chrome (Cr^{3+})	0.5	0.5	0.5
(Cr^{6+})	0.05	0.1	0.1
copper	0.01	0.1	3.0
Organoleptic:			
iron	0.5	1.0	1.5
manganese	0.1	0.3	0.8
zink	0.01	0.1	0.1

Methodological questions

1. Sampling

The processed water and silt samples were taken by young people, taking part in the Tisza-excursion, organized in 1978 by the fourth year undergraduates of the Attila József University, specialized in biology- chemistry. The sampling sites were marked out on the basis of a previous discussion, in some definite places of the longitudinal section of the Tisza, above, resp. below the characteristic inflows (Bodrog, Sajó, Zagyva, etc.). In this way, from the streamline of the river 15 water samples and from the riverside zone 15 sediment samples were carried into our laboratory.

The water samples were collected in 1-litre plastic bottles, without filtering. Previously, preserving matters (EDTA, cc. HNO_3) were put in the bottles.

The silt samples were similarly taken in 1-litre plastic bottles, in the course of sampling. Here was no preservation added.

2. Preparing, processing

Preparing, processing of the water samples

As in the Hungarian surface waters the concentration of the most heavy metals does not achieve the minimum concentration, which can be determined with the applied atomabsorption spectrophotometry, samples were enriched beforehand. Simultaneously, we strove to remove from the water the possibly disturbing components, mainly organic matters. The degree of enrichment was chosen so that even the minimum concentrations, observed by the home authors in our surface waters, can be measured (LITHERÁTY 1977, BOZSAI 1978).

From the preserved, homogenized water samples exactly 500 ml volume was taken out for investigation. To this water quantity 5 ml concentrated sulphuric acid and 25 ml nitric acid were added, then it was evaporated till the appearance of the sulphuric-acid exhalation. Was the dry-evaporated rest not transparent, then a further 5 ml concentrated nitric acid was added and dry evaporation carried out again. The dry-evaporated samples were taken up with a 1-ml 10 p.c. hydrochloric solution, then their volume was completed exactly to 100 ml in a volumetric flask. In this way, from the original water samples a fivefold enrichment was made.

Preparing, processing of sediment samples

The sediment samples carried in were carefully homogenized, then a part of them were carefully dried in an exsiccator, at 105 °C, and pulverized in a porcelain mortar. From the pulverized, repeatedly homogenized sample 5 g was exactly weighed in an assay balance and put in a 100 ml polished round-bottomed flask, and then 20 ml concentrated nitiric acid added. The flask was connected with a reflowing cooling apparatus and the matter boiled for 15 minutes. It was made grow cool for a few minutes, then 10 ml 30 p.c. hydrogen peroxide was added through the cooling apparatus. The matter was repeatedly boiled again for 15 min., then after being cooled, it was filtrated through a previously weighed G4 glass filter into a 100 ml volumetric flask. After leaching the filter with distilled water, the filtrate was poured into the volumetric flask till the mark. The determination of heavy metals was carried out from the filtrate. The residue was submitted to further heating, in order to determine the so-called correlation basis (CB: LITHERÁTY 1975).

This correlation basis is the fraction of bottom-sediment that, in addition to the calcium, magnesium salts of natural origin, contains the polluting matters coming from human activity in an enriched state, namely: the corresponding salts of heavy metals, as well as the organic matters.

3. Analytical methods

The determinations were carried out with an atomabsorption spectrophotometer of Spektromom 190A—type. The calibration curves of the single metals were recorded so that, after taking into consideration the enrichment, on the basis of the calibration curve, one-tenth of the limiting values, contained in Table 1, should still be demonstrable with the technique of atomization in flame, as well.

In case of cadmium, lead, zinc, chrome, and copper air flame was used, for determining mercury, we used the so-called cold-steam atomization (MOM collection of antecedents, 1978).

The analytical data of measurements are contained in Table 2. (PRICE 1977).

Table 2. *Analytical data of calibration measurements and sample measurements*

Metal	Wavelength (nm)	Sensitivity (μg/ml)	Limit of demonstration (μg/ml)	Manner of atomization
Hg	253,7	—	0.5	cold steam
Cd	228.8	0.01	0.002	air-acetylene flame
Pb	283.3	0.2	0.03	air-acetylene flame
Cr	357.9	0.05	0.008	air-acetylene flame
Zn	213.9	0.01	0.001	air-acetylene flame
Cu	324.8	0.04	0.002	air-acetylene flame

Results of investigations

The heavy-metal content of water samples is displayed in Table 3, the results of sediment samples in Table 4.

Table 3. *The heavy-metal content of water samples, originating from the longitudinal section of the Tisza, at the single sampling sites*

Sampling site	Heavy-metal content, µg/l					
	Hg	Cd	Pb	Cr	Zn	Cu
1. Dombrád	0.50	7.6	7.2	6.8	288	17.7
2. Above the Bodrog	2.05	2.5	0.5	4.2	100	3.9
3. Tokaj	0.50	3.3	2.4	3.4	42	4.9
4. Tiszalök	1.00	2.8	1.9	3.0	96	3.3
5. riv. km 446	0.50	3.6	2.8	3.4	29	3.9
6. Leninváros, above the Sajó	0.50	2.2	1.7	3.0	40	5.6
7. Leninváros below the Sajó	0.50	3.8	3.3	4.2	34	5.9
8. riv, km 399	0.50	2.2	3.8	3.0	1080	17.4
9. Nagykörü	0.50	1.0	1.0	1.7	29	3.9
10. Szolnok, above the Zagyva	0.80	1.1	1.2	2.2	29	3.9
11. Szolnok, below the Zagyva	1.00	2.6	2.8	4.7	336	5.2
12. Martfü	0.70	8.2	3.5	3.0	1000	7.2
13. riv. km 268	0.50	1.6	1.4	2.2	24	2.9
14. riv. km 213	0.50	3.3	3.8	3.0	78	3.6
15. riv. km 199	0.70	3.8	3.1	2.6	35	4.3
Sajó	0.50	3.3	2.4	4.2	29	4.6

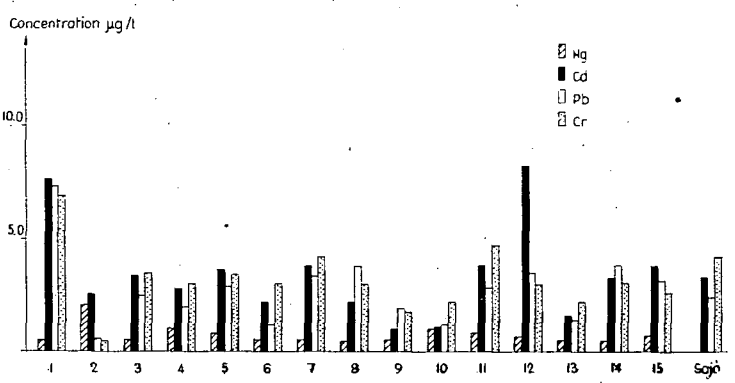

Fig. 2. Hg, Cd, Pb, Cr content of the water of the Tisza

Key to the signs used: Hg, Cd, Pb, Cr

1. Dombrád, 2. above the Bodrog, 3. Tokaj, 4. Tiszalök, 5. riv. km 446, 6. Leninváros, above the Sajó, 7. Leninváros, below the Sajó, 8. riv. km 399, 9. Nagykörü, 10. Szolnok, above the Zagyva, 11. Szolnok, below the Zagyva, 12. Martfú, 13. riv. km 268, 14. riv. km 213, 15. riv. km 199, Sajó, Sampling site.

Taking into consideration that there was only one sampling in the longitudinal section, it is not possible to draw any consequences from these data concerning the permanent pollution.

We may, however, take note of a number of tendencies:

1) The effect of the tributaries carrying the polluting matters of the industrialized area — Bodrog, Sajó, Zagyva — is obvious even from a single measurement datum.

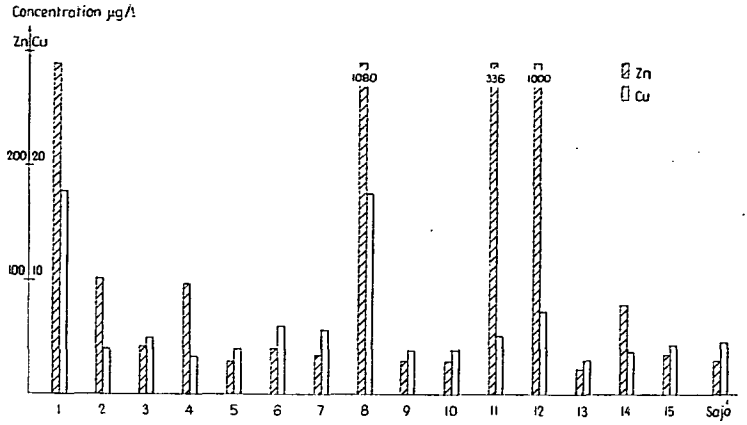

Fig. 3. Zn and Cu content of the water of the Tisza

Key to the signs used: Zn, Cu

1. Dombrád, 2. above the Bodrog, 3. Tokaj, 4. Tiszalök, 5. riv. km 446, 6. Leninváros, above the Sajó, 7. Leninváros, below the Sajó, 8. riv. km 399, 9. Nagykörü, 10. Szolnok, above the Zagyva, 11. Szolnok, below the Zagyva, 12. Martfü, 13. riv. km 268, 14. riv. km 213, 15. riv. km 199, Sajó, Sampling site.

Table 4. *The heavy-metal content of the bottom-sediment samples, originating from the longitudinal section of the Tisza, at the single sampling sites*

Sampling site	Heavy-metal content, mg/kg CB					
	Hg	Cd	Pb	Cr	Zn	Cu
1. Dombrád	0.98	0.90	0.82	4.8	67.2	100.4
2. Above the Bodrog	1.53	1.53	2.35	5.4	189.4	305.5
3. Tokaj	2.87	2.08	2.57	6.7	176.0	315.3
4. Tiszalök	2.42	2.50	3.56	10.0	262.0	375.0
5. riv. km 446	1.76	1.05	2.46	4.9	109.3	131.8
6. Leninváros, above the Sajó	1.28	1.47	1.98	3.2	114.1	179.5
7. Leninváros, below the Sajó	4.90	1.93	3.15	5.5	164.0	235.2
8. riv. km 399	0.14	1.89	2.18	2.6	154.0	259.7
9. Nagykörü	0.53	2.35	3.18	3.6	168.7	299.5
10. Szolnok, above the Zagyva	1.71	2.75	2.08	9.0	150.0	280.0
11. Szolnok, below the Zagyva	2.14	3.08	3.50	16.3	202.8	357.1
12. Martfü	1.42	2.65	2.65	5.5	165.0	305.4
13. riv. km 268	2.50	2.65	3.22	1.8	190.3	260.8
14. riv. km 213	4.80	1.18	1.48	1.6	82.6	116.6
15. riv. km 199	2.85	2.57	2.85	2.1	145.2	262.4

2) There are certain river reaches, which are polluted with heavy metals in a more increased degree. A place like this is the vicinity of Dombrád, Martfü. In these places the concentration of nearly every heavy metal is higher than in other reaches of the river.

3) The polluting effect of the Dongér in our region — riv. km 213 — can also be measured to a certain extent.

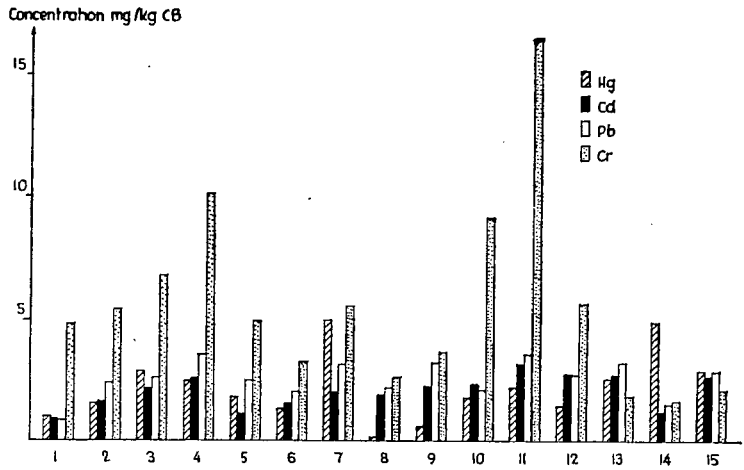

Fig. 4. Hg, Cd, Pb, Cr content of the bottom-sediment samples of the Tisza

Key to the signs used: Hg, Cd, Pb, Cr

1. Dombrád, 2. above the Bodrog, 3. Tokaj, 4. Tiszalök, 5. riv. km 446, 6. Leninváros, above the Sajó, 7. Leninváros, below the Sajó, 8. riv. km 399, 9. Nagykörü, 10. Szolnok, above the Zagyva, 11. Szolnok, below the Zagyva, 12. Martfü, 13. riv. km 268, 14. riv. km 213, 15 riv. km 199, Sajó, Sampling site.

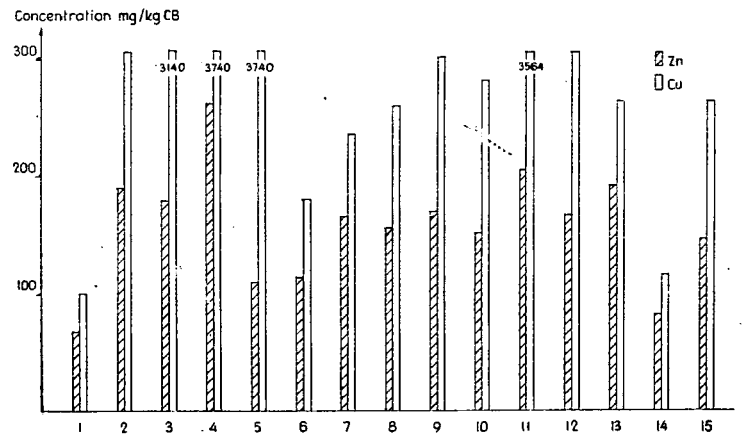

Fig. 5. Zn and Cu content of the bottom-sediment samples of the Tisza

Key to the signs used: Zn, Cu

1. Dombrád, 2. above the Bodrog, 3. Tokaj, 4. Tiszalök, 5. riv. km 446, 6. Leninváros, above the Sajó, 7. Leninváros, below the Sajó, 8. riv. km 399, 9. Nagykörü, 10. Szolnok, above the Zagyva 11. Szolnok, below the Zagyva, 12. Martfü, 13. riv. km 268, 14. riv. km 213, 15. riv. km 199, Sajó, Sampling site.

As the tendencies are known, it is very important to repeat this task in the future by means of manifold samplings and to make a survey in our area of the polluting foci of heavy metals, water-courses, having an effect on the Tisza.

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A Tisza folyó víz- és fenéküledék mintáinak nehézfém vizsgálata

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Alsó-Tiszavidéki Vízügyi Igazgatóság Szeged

Kivonat

A szerzők Magyarországon először határozták meg a Tisza vizének és iszapjának nehézfém tartalmát, a folyó teljes hossz-szelvénye mentén. Megállapításaik szerint vannak a folyónak olyan szakaszai, melyek fokozottabb mértékben szennyezettek nehézfémekkel. Ilyen pl. Dombrád és Martfű térsége. Ezeken a helyeken majd minden nehézfém koncentrációja magasabb, mint más folyószakaszokon. Az iparvidékek szennyező anyagait szállító mellékfolyások, mint a Bodrog, Sajó, Zagyva hatása nyilvánvaló.

АНАЛИЗ ОБРАЗЦОВ ПРОТОЧНОЙ ВОДЫ И ОТЛОЖЕНИЙ ДНА Р. ТИСЫ НА СОДЕРЖАНИЕ ТЯЖЁЛЫХ МЕТАЛЛОВ

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Резюме

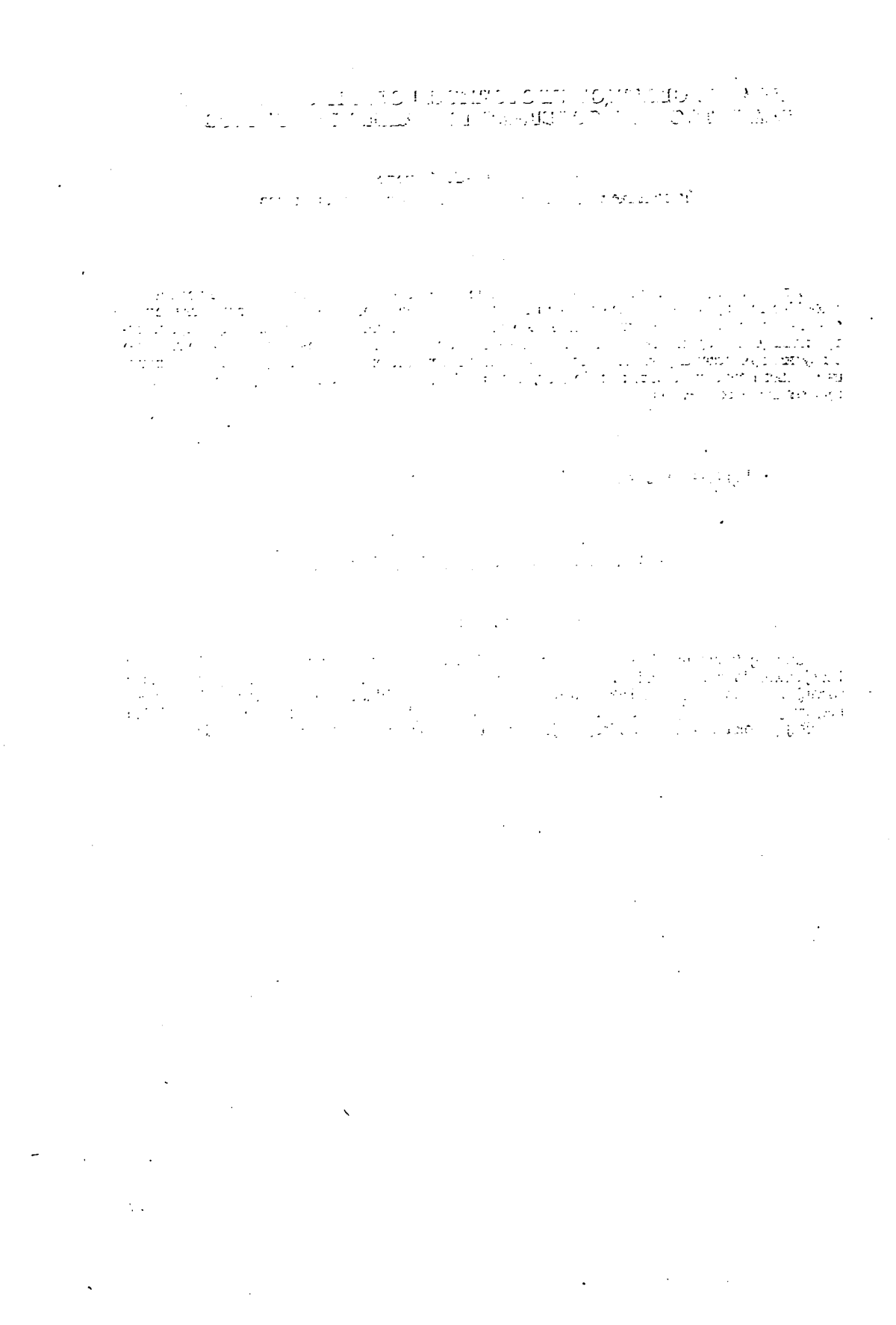
Авторы впервые производили определение содержания тяжёлых металлов в воде и иле реки Тисы на протяжении всей длины реки. Ими установлено, что река имеет участки, отличающиеся значительной загрязнённостью тяжёлыми металлами. Таковы, например, пространства Домбрад и Мартфю. На этих участках наблюдается повышенная по сравнению с другими участками реки концентрация почти всех тяжёлых металлов. Здесь очевидно влияние таких приточных вод, как Бодрог, Шайо и Задьва, несущих загрязняющие материалы промышленных районов.

Ispitivanje teških metala u uzorcima vode i mulja reke Tise

Fügedi Klára i Fekete E.
Vodoprivredna uprava donjeg područja Tise Szeged

Abstrakt

Sadržaj teških metala uzdužnog profila vode i mulja Tise prvi put su odredjivali autori u Madjarskoj. Prema dobijenim rezultatima autori su utvrdili da reka ima deonice koje su znatnije zagadjene teškim metalima. Takva su područja na pr. Dombrád-a i Martfü-a. Na navedenim područjima je koncentracija skoro svih teških metala veća u odnosu na druge deonice reke. Očigledan je uticaj pritoka kao što su Bodrog, Sajó, Zagyva koje donose industrijske otpadne vode.



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HYGIENIC INVESTIGATION OF THE TISZA-WATER, AND THE DRINKING-WATER MADE OF THAT, WITH THE MODIFIED DAPHNIA TEST

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Abstract

The author carried out investigations, with Daphnia-test procedure, to form a judgment of the toxicity of the water of the Tisza and of the drinking-water, obtained from this. 54.4 per cent of the altogether 546 Tisza-water samples, investigated in the period from February 1974 till October 1979, were positive (Lc $50 < 48^h$). A close connection could be established between the values of water-level and Daphnia-positivity. The positivity belonging to the single water-level values is the greatest at ± 100 cm water-levels, close to 0-level: 62.1 per cent (average value) of the samples, investigated in this province. A rising water-level enables a decrease in the toxic material concentration, which supposedly moves at an approximately standing value. This had no more any harmful effect on Daphniae, at a determined cc.m/s, within a 48-hour exposition. Corresponding to this, according to our investigations, the water of the Tisza only ceased to be toxic to Daphniae in the days of great floods, above Szolnok at a high water of about 900 cm, which means an the eightfold increase in the water output at 0-level. Positivity occurred not only when a micropolluter was present in a lethal concentration to Daphniae, but often in cases, as well, when the single micropolluters were present separately in sublethal quantities. The perdition of Daphniae may supposedly be explained with the synergetic effect, which is rather dominant in the interactions of the micropolluting materials.

It follows unambiguously from the results of the Daphnia-test investigations of drinking-water that the degree of the purifying efficiency of the town surface water-work must be further improved because 49.6 per cent of the altogether 546 samples proved to be positive.

Introduction

In the special literature several data may be found, which more and more emphasize the importance of making inquiries in the interest of protecting the purity of waters and water life. Recently it became unquestionable that a number of the necessary answers are given by the investigations into toxicity (TARZWELL 1962, 1966). Though these investigations are mostly non specific, nevertheless they enable a qualitative evaluation in respect of toxicity.

Without striving after completeness, we are mentioning that more than one publication dealt with the problem of the biological investigation and qualification of the water of the Tisza (MEGYERI 1970, 1971, UHERKOVICH 1971), with the changes induced by the Kisköre river barrage (ÁDÁMOSI—BANCSI—HAMAR—KATONA—B. TÓTH—VÉGVÁRI 1974, CSUKA 1970). The presence, investigation or indication of the toxic and cumulated matters, getting into the Tisza, was not treated by any of these papers.

Since 1974, our laboratory has dealt with the indication of the toxicity of waters. On the first occasion in 1974, then following this, in 1976, we reported on our inves-

tigations in connection with this (PALICSKA—CSÉPAI—HŐGYE 1974, 1976). We are convinced that the matters of foreign origin, which can be demonstrated from the water of the Tisza, edanger the living world of the Tisza and have an importance in the relation of public health, as well, that cannot be left out of consideration.

The disturbances emerging in connection with the drinking-water supply of the town Szolnok and environs are also first of all of qualitative character: the taste and smell complaints, lodged by the population frequently, are also to be brought into a close connection with the pollution of the Tisza and the not satisfying degree of clearing by the water-work built on the river.

These facts have justified the elaboration and routinish application of a testing process, which — despite its simplicity — makes possible the systematic, fast, and informative estimation of the toxicity of the Tisza and of the drinking-water, made of its water. Earlier, we already discussed in detail the laboratory breeding and preserving of Daphniae, used as test-organisms for this purpose (CSÉPAI 1975). In the following we are reporting on our test procedure and the results of our investigation.

Materials and Methods

From February 1974 till October 1979 we investigated, with a regularity of about every four days, into 546 samples, from drinking-water sterilized with chlorine similarly into 546 samples.

The sampling site of the Tisza-water samples is the Tisza above the surface water-work of the town Szolnok.

The sampling place of the drinking-water, sterilized with chlorine, is the Station of Public Hygiene and Epidemics of County Szolnok, the wall-tap of the central dining-hall, in Szolnok.

(a) The sample preparation of the Tisza-water

From the filtered Tisza-water, 2×200 ml are parallel measured out into 250 ml tumblers then 2 times diluted samples were also made, similarly in a 2×200 ml total volume. The earlier described solution (CSÉPAI 1975) was used as diluent. Before putting in the test organisms, the undiluted samples and the twice diluted ones were placed into the semi-dark part of an indicated room, which is free from chemical vapours, where the temperature is set at about 20° C (±3° C) for 2 to 3 hours. Then we put in each vessel twelve Daphniae magnae in the third grade of development, from our breeding stock and leave the samples without mixing and ventilating for 48 hours.

(b) Preparation of the chlorinated drinking-water sample

In the drinking-water, the concentration of free chlorine and chloroamines, which endanger Daphniae, fluctuates — according to our investigations — within wide limits. The first important step is, to neutralize and reliably inactivate these.

For this purpose Na-thiosulphate was applied. It may be considered as a lucky circumstance that sodium thiosulphate does not mean any danger to Daphniae from physiological point of view. Thus, in the routine work we could avoid to determine the total chlorine content before testing the drinking-water in order to establishing the quantity of sodium thiosulphate, necessary to inactivation.

The minimum safety value was determined so that the maximum value was selected from the results of our total-chlorine investigations of drinking-water performed in the preceding five years and the quantity of sodium thiosulphate, equivalent to this, was added to the water samples in a model experiment. In these samples Daphniae did not perish. The additional experiments aimed at investigating into the consequences of a possible overdosage of thiosulphate. We have established that even a fiftyfold (!) quantity of the theoretically calculated thyosulphate has no harmful or destructive effect on Daphniae. For security reasons, however, the quintulpe of the absolutly necessary value has been applied and this is given in ml/l in the practical work. It follows, therefore, from the foregoing that 0.5 ml Na-thiosulphate/litre drinking-water, sterilized with chlorine, proved to be reliable for the "overensuring" physiological neutralization of the total chlorine content, which has so far been highest, according to our measuring.

The 1 litre drinking-water, prepared in this way, is left in room-temperature for a few hours. Further on, we have acted as described in the above point.

(c) Control water sample

For control and diluting water sample, we use drinking-water, perfused through an active carbon column (CSÉPAI 1975), controlling with it the faultless quality of the Daphnia material and the diluting water. In 200 ml of this, we put, like before, 12 Daphniae.

It is to be noted concerning all the samples that, during the investigation, the test organisms do not get any food. If Daphniae perish in the control vessel, the test cannot be appreciated.

(d) Appreciation of tests

The evaluation of tests takes place after 48 hours, resp. within this, when — if possible — we follow with attention and record the changes in the akinesia of Daphniae. We had to decide in the formal relations of giving the results. It turned out from the special literature at our disposal that in the water toxicological works no uniform terminology has taken shape, as yet. In selecting from possibilities, we have primarily relied on Sprague's comprehensive critical review (1975) and on the French Water-biological STANDARD (1974). On this basis, we identify the expression "medium lethal level" with the symbol LC 50, completing this designation by indicating the length of exposition, because time and concentration are inseparably connected in case of the tests carried out on water organisms. We have set up as a criterion of the water acceptable from hygienic point of view that the water of the Tisza, resp. the drinking-water samples, may not contain any higher value than that of the concentration of a toxic matter, corresponding to a 48-hour long medium survival, because if they do contain that then: LC $50 < 48^h$ and we regard the sample as positive. In order to study the effect of the diluting water, we set always in double-diluted samples, as well.

Taking into consideration the facts mentioned above, we have summarized the method of giving the results of Daphnia tests in the following:

In case of a negative result (medium survival):

1) The undiluted water sample is negative after LC $> 50\ 48^h$.
2) The water sample of double dilution is negative after LC $> 48^h$.

In case of a positive result:

1) The undiluted water sample is positive after LC 50 (e.g.) 32^h.
2) (a) The water sample of double dilution is positive after LC 50 (e.g.) 32^h.
   (b) The water sample of double dilution is positive after LC $< 50\ 48^h$.

Results

The results of the Daphnia tests of the Tisza water and the chlorinated drinking-water, in the period between 1974—1979, are summarized in Table 1. It turns out of this, besides other data, that 52.4 per cent of the undiluted Tisza-water samples and 49.6 per cent of the undiluted drinking-water samples proved to be positive.

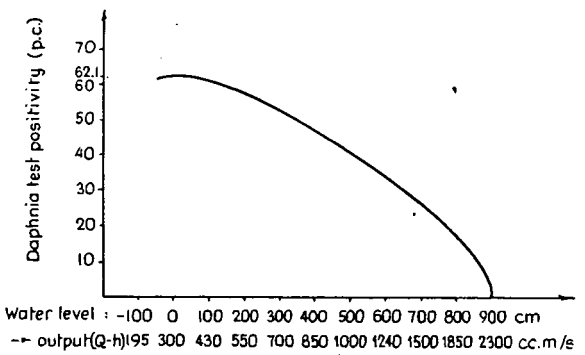

Fig. 1. The percentage distribution of 286 positive Tisza-water samples, plotted against the changes in water levels and water outputs, between February 1974 and October 1979.

Figure 1 displays a diagram about the connection between the percentile distribution of the positive Tisza-water samples and the change in water level and water output. We have indicated on the abscissa the water levels of the Tisza and the values of the Q-h curve belonging to these, expressed in cc.m/s; and on the ordinate the positive sample number compared with the total sample number of the single water-output domains, expressed in percentage. It may be read off from the Figure that 62.1 per cent (averaged value) of the contested samples fall on the water-level values close to the 0-level ± 100 cm. The gradual increase in the water output induces a decrease in the percentage of the positive water samples. Owing to the higher and higher and dilution, every sample becomes negative at last, in case of 2300 cc.m/s (+900 cm) water output, which is about eightfold of the value belonging to the 0-level.

Discussion

Despite the high sensitivity of Daphinae to toxic materials, it is true that e.g. the fishes in the Tisza have not yet given, luckily, any immediate answer. But with the full knowledge of the data of the special literature, this establishment does not seem to be reassuring. The danger of the so-called chronic intoxications does exist. It is rightly urged that, for clearing up its causes, the sublethal action-mechanisms ought to be studied. It is said, with good reason, that the fish population is damaged by the micropolluters of lasting effect much more seriously and for a longer period than by cases of an acute poisoning.

It would be a fault to leave the possibility of this out of consideration — though without exaggerating it. In the Tisza — according to our (PALICSKA—CSÉPAI—HŐGYE 1976) chemical investigations — the following micropolluters may be found, in a fluctuating concentration:

Permanently:

Phenol (Phenol, 4-chlorophenol, α-naphthol)
Lindan,
Detergent (anionactive),
Oil,
Metal-ions (Ti, Cr, Ni, Cd, Bi, Pb)

In exceptional cases:

Zn, Hg.

Some of these can get through the filtering units of the water-work into the drinking-water:

Phenol-derivatives,
Lindan,
Oil,
Metal-ions.

Though the materials, which are harmful to the above-listed living organisms, are separately at a sub-lethal level, we must conclude from the frequent positive test results some additive, and even synergetic effects, though opposite to all these, some antagonistic effects can also occur. This extremely complex problem is further

complicated by the changes in the concentration and combination of the enumerated matters, together with the rhapsodical changes in the water level of the Tisza. It is doubtless, too, that in the formation of the toxic effect, some modifying factors — like the different abiotic conditions, e.g., temperature, mineral-matter content, etc.) — have also some part.

Returning to the results of our investigation, it is to be noted, that — for reaching a harmless concentration — the samples of crude water, which were on two occasions prominently positive (LC 50 3^h), were to be diluted fivefold. But the dilution of the Tisza due to flood must be of much greater degree, for creating a harmless concentration under natural conditions. The cause of this may be that newer chemicals are washed in by the river from the inundated areas and thus the level of the micropolluters being always present at normal water level, which level fluctuates around a constant concentration value, rises.

Table 1. *Tisza-water and drinking-water samples. Results of Daphnia test between 1974—1979*

Water-type	Investigated sample together	Positive samples (LC 50<48^h) without dilution		twofold diluted	
		no.	p.c.	no.	p.c.
Tisza-water	546	286	52.4	217	39.7
Drinking water	546	271	49.6	195	35.7

The perishment of Daphniae only terminates if the rise of the water level becomes extremely high. On this occasion, the toxic-matter content of the Tisza water falls much more under the critical threshold, the water quality vies with the control (Fig. 1).

The results of the drinking-water investigations are showing a comparatively more favourable picture than those of the Tisza-water. From the parallel performed investigations it turns out, as well, that the changes measured with Daphnia tests in the concentration of micropolluters in the drinking-water are not significant of the connections between the water level of the Tisza and the toxic material content, showing a certain regularity. These facts can be explained with that the oxidative and adsorptive capacity of the water-work is incalculable, accidental, and remains under the demands. As a result of this, the degree of efficiency of the clearing capacity is changing, its regulation is, in respect of the chemical polluters, not duly solved, at present.

It is shown by our above investigation series and the experiences of our connected work that the water-toxicologic investigational principles, which are valid in the non-sanitarian field, can reliably be applied — with some modifications — in the hygienic evaluation of the surface waters and the drinking-waters, obtained from these. We shall continue our Daphnia-test investigations, apart from introducing other biological tests, and hope to be able to contribute with our work to the satisfying functioning of the modern surface water work, the building of which is in the process of completion.

*

I should like to record in this place my gratitude to the assistents Mrs. F. KISZELY and Mrs. SZALAY MÁRIA DOBOS for their valuable work performed in the course of setting breed and test.

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Tisza-víz és ebből nyert ivóvíz higiénés vizsgálata módosított Daphnia teszttel

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Kivonat

Szerző módosított *Daphnia* teszt eljárással vizsgálatokat végzett a Tisza-víz és az ebből nyert ivóvíz toxicitásának megítéléséhez. Az 1974—79 közötti időszakban összesen 546 Tiszavíz-minta vizsgálata szerint 52,4%-a volt pozitív (LC $50 < 48^{h}$). Ennek megfelelően a Tisza vizének toxicitása a *Daphniákra* csak nagy árvizek idején szűnik meg. A *Daphniák* pusztulása feltehetően a mikroszennyező anyagok kölcsönhatásaiban inkább domináló színenergetikus hatással magyarázható. Az ivóvíz *Daphnia*-teszt vizsgálatai alapján kitűnt, hogy a Szolnok városi vízmű tisztítási hatásfokát tovább kell javítani, mert a megvizsgált minták 49,6%-a pozitívnak bizonyult.

ГИГИЕНИЧЕСКИЙ АНАЛИЗ ВОДЫ РЕКИ ТИСЫ И ПОЛУЧЕННОЙ ИЗ НЕЁ ПИТЬЕВОЙ ВОДЫ С ПОМОЩЬЮ ВИДОИЗМЕНЁННОГО ТЕСТА Daphnia

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Резюме

Автор производил исследования по определению токсикации воды р. Тисы и полученной из неё питьевой воды с помощью видоизменённого теста Daphnia. В период с 1974 по 1979 гг. было проведено 546 анализов, 52,4% которых оказались положительными (LC 50 <48). В соответствии с этим, токсикация воды Тисы не наблюдалась только в период больших наводнений. Гибель Daphnia объясняется, вероятно, доминирующим во взаимовлиянии микрозагрязняющих материалов число знергетическим влиянием.

На основе анализов питьевой воды с помощью теста Daphnia видно, что необходимо дальнейшее улучшение эффективности гидростанции Сольнока, так как исследованные образцы на 49,6% оказались положительными.

Ispitivanje sanitarnih svojstava vode reke Tise i vode za piće dobijene iz reke modifikovanim Daphnia testom

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Abstrakt

Autor je pri ispitivanju koristio modifikovan *Daphnia* test za odredjivanje toksikološkog dejstva vode Tise kao i vode za piće dobijene iz reke. Od ukupno 546 analiziranih uzoraka vode Tise u periodu 1974—79. 52,4% je bilo pozitivno (LC $50<4^h$). Shodno tome toksičnost vode Tise na *Daphnie* prestaje samo za vreme velikih poplava. Može se pretpostaviti tumačenje da do uginuća *Daphnia* dolazi pre svega usled uzajamnih dejstava dominantnih sinergetičnih mikrozagadjivača.

Ispitivanjem uzoraka vode za piće *Daphnia* testom utvrdjen je pozitivan nalaz u 49,6% analiziranih uzoraka. Na osnovu toga proizilazi potreba daljeg poboljšavanja stepena prečišćavanja gradskog vodovoda Szolnok-a.

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SEDIMENT INVESTIGATIONS CARRIED OUT IN THE LONGITUDINAL SECTION OF THE TISZA AND IN THE MOUTH OF ITS MAJOR TRIBUTARIES FOR ESTABLISHING THE PRESENCE OF FAECALINDICATOR BACTERIA

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Abstract

The author has carried out sediment investigations in the longitudinal section of the river Tisza from riv. km 689 till riv. km 172, as well as at 76 sampling sites in the mouth of tributairies. He has determined the Coliform, Faecal coliform and Faecal streptococcus number of samples, in MPN value, referring these to 1 g wet sediment. As this is the first sediment-bacteriological investigation in the longitudinal section of the Tisza in Hungary, thus the author gives the numerical values of the faecal bacteriological pollution of the simple sampling sites and shows them in a graph, as well.

He calls the attention to the importance of sediment investigations for the bacteriological evaluation of surface waters.

Introduction

The sediment-bacteriological investigation of the Tisza reached completion in the whole home stretch of the river at first on the occasion of the expedition, organized in August-September 1979.

The most generally accepted group of faecal pollution is that of Coliform bacteria (Standard Methods 1965). The Coliform bacterium may be of faecal origin but it can also be found in other places, thus in plants, water, silt, soil, etc. Only a part of these can develop at 44 °C. In certain opinions, all of them are considered as E.coli. But this is an error because other strains are frequently present among the colonies growing at a temperature like this (COHEN, SHUVAL 1973).

The bacteriological state of the water of the river Tisza was dealt with by more than one person (PAPP 1965, VETRÓ et al. 1966, DEÁK et al. 1975, ESTÓK et al. 1977, 1978) but silt-sediment investigations have not taken place in the longitudinal section of the Tisza, as yet. Just therefore, it seemed necessary to take up the sediment-bacteriological state of the Tisza and, within this, to clear up the quantitative conditions of the faecal indicator bacteria in the river Tisza and in the mouth of the major tributaries, as well.

The method of our investigation was founded on home experiences. This filters out the false results of the concomitant bacterial flora, which is always present in the silt (SZABÓ 1974). In the hygienic bacteriological practice, beside the demonstration of the faecal coliform number, the other reliable indicator of the faecal pollution is the presence of Faecal streptococcus (DAUBNER 1972).

Materials and Methods

The sediment samples were taken by the personnel of the research ship of the expedition, with sterile instruments, from the left- and right-side sections of the Tisza, resp. the tributaries, out of the upper 2 cm layer of the sediment. The samples taken were carried in a cooling bag, the same day, into the Water Bacteorological Laboratory of the Station of Public Hygieny and Epidemics of County Heves, where the processing of them took place.

To the investigations to be done we have not found any standardized methodical description, therefore we have worked with a method, already applied in the home practice in soil microbiology, food microbiology, and at the investigation into the silt of certain surface waters (CSATAI 1973, National Institute of Public Hygiene: Methodological Guide 1977, Hung.; OTKI Notes 1970, Hung.).

10 g of silt samples were put in physiological saline solution, in order to get a 10 p.c. suspension. These suspensions were homogenized in a shaker for 15 minutes. After shaking, 1 ml from dilutions of each sediment suspension was put in the enterobactericeae-concentrator. From every dilution, three tube-concentrations were made. Dilution was made till scale 10^7, then incubation followed at 37 °C, for 24^h. Then surface streaking followed on Endo culture medium from the tubes showing some turbidity. This was again incubated at 37 °C, for 24^h. Then we have recorded, on how many Endo plates typical Coli colonies were found. From the positive plates, we transoculated into a bouillon of lactose content and incubated at 44 °C, for 24^h. The tubes forming gas and solving lactose were regarded as pozitiv.

On the basis of the positive Endo plates the Coliform, and on the basis of the bouillon-tubes of lactone content the Faecal coliform number is given in MPN (Most probable number) value (THATCHER-CLARK 1968).

For demonstrating the faecal streptococci, we put the earlier described quantities from the dilutions into Litsky-Malman's concentrator and incubated them at 37 °C for 48^h. Here we worked till 10^4 dilution because of the prospectively lower values.

Then from the tubes showing turbidity we made surface streaking on Szita's culture media E_{67}. On the culture medium, on the basis of positive tubes, showing a typical colony-morphology, we give the faecal streptococcus number similarly in MPN value.

Results

The performed investigations closed with varied results, which results can only partly be explained unambiguously. At the same time, the results of the entire longitudinal section can be evaluated only by comparing them with the other investigated bacteriological, physical, chemical, etc. parameters, and certain conclusions can only be drawn in this way.

The results are varied but the Faecal coliform No/g value is always lower than the Coliform No/g value in the whole strech of the Tisza, resp. in the sediment of tributaries.

We have got saliently high values in case of both parameters in the tributaries Bodrog, Sajó, Zagyva, and Maros, as well as in the Szeged section of the Tisza (3 km below the Maros). It exceeds the order of magnitude 10^6 in the sediment of the Sajó — what can be understood if we take into consideration that the Sajó gets 85,000 cc.m/day industrial and 71,000 cc.m/day household wastewater. Despite this, in the sediment 1 km below the Sajó, resp. in that of the 3 km Tisza section, this value is reduced by 2—3 order of magnitude — what can be explained by the strong dilution and the intensive self-purification.

In the sediment samples taken from the Kisköre Reservoir, we have got very low Coliform No/g values. From Kisköre till the mouth of the Zagyva, the investigated parameters were of 10—10^2 order of magnitude. The following strongly salient Coliform values were determined from the sediment of the Zagyva section (2.4×10^6 Coliform number, 9.3×10^5 Faecal coliform number). This massive sediment pollution can be explained partly as a consequence of the strong wastewater load (10,000 cc.m/day industrial, 4,000 cc.m/day household, and about 2,000 cc.m/day mixed waste-

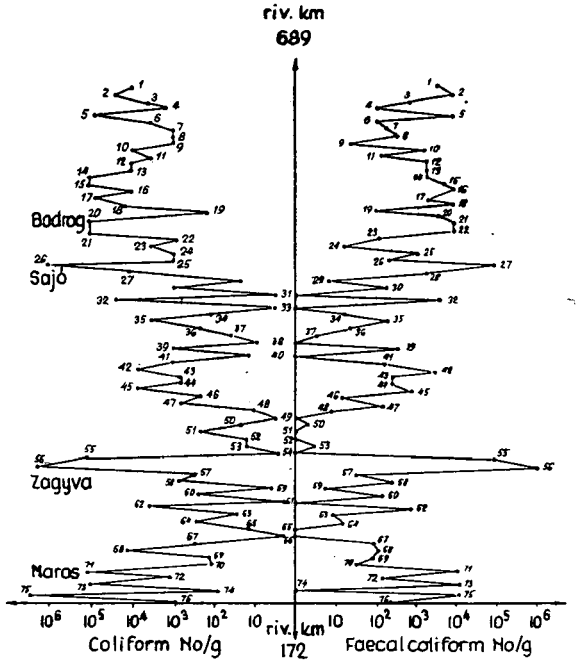

Fig. 1. Coliform, Faecal coliform number in 1 g wet sediment.

water) and partly by the extremely low water level in the time of sampling. Below the Zagyva, in the sediment of the Tisza, the Coliform and Faecal coliform/g value were only of 10^2 order of magnitude.

On the occasion of investigating into the whole longitudinal section, the highest Coliform value was measured in the 3 km Tisza-section, lying under the influence of the river Maros ($4{,}6 \times 10^6$). This may partly be explained by the settling of the Maros sediment, partly supposedly by the wastewater inflows at Szeged.

On the basis of the performed investigations, the Faecal Streptococcus number, indicating the fresh faecal pollution, was the highest in the Zagyva section, because of the facts described above. Almost 1/3 part of the samples proved to be negative. The most favourable state was registered in the Körös section and in the Tisza section below the Körös, where the Faecal streptococcus No/g value was negative in more than one sample.

On the basis of the performed investigations, among the tributaries of the Tisza, the sediments of the Bodrog, Sajó and Zagyva were the most polluted. There can be demonstrated essential differences between the sections on the right and on the left. Here we should obviously take into consideration, on which side the wastewater inflows take place, as well as the flowing conditions of the rivers.

It may be established from the investigations into the sediment samples of the Tisza that the massive pollution of tributaries is considerably reduced, as a result of the intensive self-purification and the strong dilution. This is not verified only in the 3 km section below the Maros.

Comparing the water and sediment investigations of the Tisza and tributaries

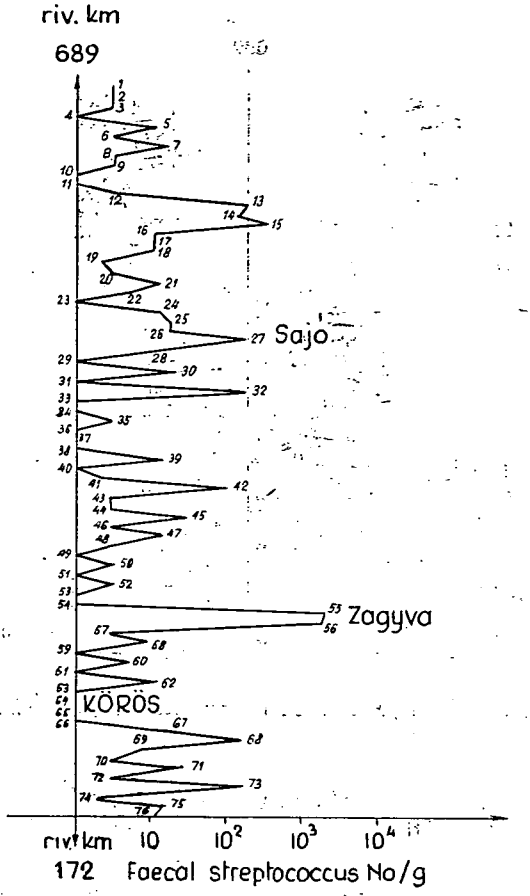

Fig. 2. Faecal streptococcus No/1 g in a wet sediment.

(though the two investigations took place with different methods), it is to be established that the most pollutions are carried by the Bodrog, Sajó, and Zagyva, which have a very high inorganic matter load. — In the settled silt the bacteria of faecal origin achieve a higher relative value than in the water.

In the silt, a larger mass of bacteria live, thus also more bacteria of faecal origin. Here the decomposition of organic matter is more intensive. At present, the Tisza is still able to reduce the bacteriological pollution of tributaries by the process of its self-purification. But if the pollution stronger increases, this may become doubtful.

It is worth considering if in river reaches, where a massive faecal pollution of the sediment is proved, bathing should be prohibited, respectively the creation of open-air baths should not be permitted.

At present, the hygienic evaluation takes only place on the basis of water investigations. In the course of our investigations, it was proved that in the bottomsediment of the surface waters loaded with wastewaters the bacteria indicating the faecal pollution are present in a much higher number than in the water itself. Consequently, the probability of the presence of the enteral pathogenic bacteria is higher, as well.

Table 1. *Sediment investigation into the Tisza and its tributaries*
28 August — September 15, 1979

Sample number	Code	Section	Coliform No/g	Faecal coliform No/g	Faecal streptococcus No/g
1	01103	Tisza, above Szamos, left	21,000	7,500	4
2	01203	Tisza, above Szamos, right	46,000	15,000	4
3	02103	Szamos, left side	7,500	1,500	4
4	02203	Szamos, right side	9,900	240	Ø
5	03103	Tisza, below Szamos, 1 km left	110,000	12,000	11
6	03203	Tisza, below Szamos, 1 km right	7,500	240	4
7	04103	Tisza, below Szamos, 3 km left	1,500	390	23
8	04203	Tisza, below Szamos, 3 km right	1,500	750	4
9	05103	Tisza, above Lónyai Channel, 1 km left	1,111	43	4
10	05203	Tisza, above Lónyai channel, 1 km right	11,000	4,600	Ø
11	06103	Lónyai channel, left side	4,600	240	Ø
12	06203	Lónyai channel, right side	15,000	4,600	4
13	07103	Tisza, below the Lónyai channel, 1 km lef	15,000	4,600	240
14	07203	Tisza, below the Lónyai channel, 1 km right	110,000	4,600	150
15	08103	Tisza, below the Lónyai channel, 3 km left	110,000	7,500	460
16	08203	Tisza, below the Lónyai channel, 3 km right	21,000	15,000	9
17	09103	Tisza, above Bodrog, 1 km left	93,000	4,600	11
18	09203	Tisza, above Bodrog, 1 km right	21,000	12,000	9
19	10103	Bodrog, left side	240	240	3
20	10203	Bodrog, right side	110,000	7,500	4
21	11103	Tisza, below Bodrog, 1 km left	110,000	15,000	15
22	11203	Tisza, below Bodrog, 1 km right	110,000	15,000	7
23	12103	Tisza, below Bodrog, 3 km left	1,400	210	Ø
24	12203	Tisza, below Bodrog, 3 km right	4,600	30	15
25	13103	Tisza, above Sajó 1 km left	1,500	2,400	23
26	13203	Tisza, above Sajó, 1 km right	1,500	460	23
27	14103	Sajó, left side	1.100,000	150,000	240
28	14203	Sajó, right side	21,000	4,600	9
29	15103	Tisza, below Sajó, 1 km left	43	9	Ø
30	15203	Tisza, below Sajó, 1 km right	1,100	460	23
31	16103	Tisza, below Sajó, 3 km left	4	Ø	Ø
32	16203	Tisza, below Sajó, 3 km right	46,000	7,500	240
33	17103	Tisza, above Leninváros, left side	4	Ø	Ø
34	17203	Tisza, above Leninváros, right side	240	9	Ø
35	18103	channel of thermal power station, left side	7,000	460	4
36	18203	channel of thermal power station, right side	460	43	Ø
37	19103	Tisza, below Leninváros, 1 km left	75	4	Ø
38	10203	Tisza, above Leninváros, 1 km right	9	Ø	Ø
39	20103	Tisza, below Leninváros, 3 km left	2,800	750	23
40	20203	Tisza, below Leninváros, 3 km right	23	Ø	Ø
41	21103	Tisza at Tiszakeszi, left side	2,100	200	3
42	21203	Tisza at Tiszakeszi, right side	9,300	1,500	93
43	22103	Tisza at Tiszacsege, left side	930	430	4
44	22203	Tisza at Tiszacsege, right side	930	430	4
45	23103	Tisza at Tiszafüred, left side	9,300	930	43
46	23203	Tisza at Tiszafüred, right side	300	23	4
47	24103	Tisza at Tiszaderzs, left side	930	120	15
48	24203	Tisza at Tiszaderzs, right side	14	9	4
49	25103	Tisza at Kisköre, left side	4	Ø	Ø
50	25203	Tisza at Kisköre, right side	43	3	4

Sample number	Code	Section	Coliform No/g	Faecal coliform No/g	Faecal streptococcus No/g
51	26103	Tisza at Tiszabura, left side	430	∅	∅
52	26203	Tisza at Tiszabura, right side	23	∅	4
53	27103	Tisza, above Zagyva, left side	23	4	∅
54	27203	Tisza, above Zagyva, right side	4	∅	∅
55	28103	Zagyva, left side	210,000	150,000	2,400
56	28203	Zagyva, right side	2,400,000	930,000	2,300
57	29103	Tisza, below Zagyva, 1 km, left	640	43	4
58	29203	Tisza, below Zagyva, 1 km right	930	460	9
59	30103	Tisza, below Zagyva, 3 km left	7	7	∅
60	30203	Tisza, below Zagyva, 3 km right	430	230	7
61	31103	Tisza, above Csongrád, left side	3	∅	∅
62	31203	Tisza, above Csongrád, right side	7,500	930	15
63	32103	Körös, left side	43	9	∅
64	32203	Körös, right side	430	28	∅
65	33103	Tisza, below Körös, 1 km left	23	∅	∅
66	33203	Tisza, below Körös, 1 km right	3	∅	∅
67	43103	Tisza, below Körös, 3 km left	430	93	20
68	34203	Tisza, below Körös, 3 km right	23.000	150	230
69	35103	Tisza, above Maros, 1 km left	230	93	9
70	35203	Tisza, above Maros, 1 km right	150	43	4
71	36103	Maros, left side	120.000	15.000	43
72	36203	Maros, right side	1.500	240	4
73	37103	Tisza, below Maros, 1 km left	150.000	21.000	240
74	37203	Tisza, below Maros, 1 km right	93	∅	3
75	38103	Tisza, below Maros, 3 km left	4.600.000	15.000	23
76	38203	Tisza, below Maros, 3 km right	930	430	15

This means a problem first of all, where the water, demarkated for bathing, is shallow and thus, at bathing, the potential infectivity of water is increased by the stirring of silt.

Thus, it seems to be advisable to investigate into the sediments of rivers, resp. lakes, loaded by organic matter and utilized for sport, and to take into consideration the results of investigation, as well, from the point of view of the hygienic evaluation.

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A Tisza hossz-szelvényében és jelentősebb mellékfolyói torkolatában végzett üledékvizsgálatok fekálindikátor baktériumok jelenlétére

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Kivonat

Szerző a Tisza folyó hossz-szelvényében a 689—172 folyó km közötti ,valamint a mellékfolyók torkolatában 76 mintavételi helyen végzett üledékvizsgálatokat. A minták Coliform, Faecal coliform és Fecal streptococcus számát határozta meg, MPN értékben, 1 g nedves üledékre vonatkoztatva Ez az első üledék bakteriologiai vizsgálat a Tisza folyó magyarországi hossz-szelvényében. Szerző megadta az egyes mintavételi helyek fekális bakteriológiai szennyezettségének számszerű értékeit. Felhívja a figyelmet a felszíni vizek bakteriológiai megítélésénél az üledékvizsgálatok jelentőségére.

ПРОВЕДЕННЫЕ НА ПРОДОЛЬНОМ ПРОФИЛЕ ТИСЫ И В УСТЬЯХ ЕЁ БОЛЕЕ ЗНАЧИТЕЛЬНЫХ ПРИТОКОВ АНАЛИЗЫ ОТЛОЖЕНИЙ НА ПРИСУТСТВИЕ ФЕКАЛ-ИНДИКАТОРНЫХ БАКТЕРИЙ

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Резюме

На участке Тисы в 689—172 п. км, а также в устьях её притоков автор провёл а нализ отложений на месте взятия 76 проб. Было проведено опеределение числа Coligorm, Faecal coliform И Fecal streptococcus, в показателе MPN.

В пересчёте на Iг влажных отложений. Это — первое бактериологическое исследование отложений на всём протяжении Тисы в Венгрии. Автор приводит количественные показател фекальной бактериологической загрязнённости в местах взятия проб. Обращает внимание на значение анализов отложений при бактериологической оценке поверхностных вод.

Ispitivanje prisutnosto fekalni-indikatornih bakterija u mulju uzdužnog profila Tisei na uššu njenih značajnijih pritoka

Estók B.
Zdravstvena i epidemiološka stanica Eger

Abstrakt

Autor je na uzdužnom profilu reke Tise izmedju 689 i 172 rečnog Km kao i na uščima pritoka na 76 punktova uzimao uzorke za analizu sedimenata. Uzorci su analizirani u odnosu na g vlažnog sedimenta, na broj Coliform, Fecal coliform i Fecal streptococcus u MPN vrednostima. Ova su prva sedimentno-bakteriološka ispitivanja na uzdužnom profilu reke Tise u Madjarskoj. Autor je prikazao vrednosti fekalno-bakteriološke zagadjenosti na pojedinim punktovima uzimanja uzoraka. Ukazuje se na značaj istraživanja sedimenata pri utvrdjivanju bakterioloških svojstava površinskih voda.

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HYGIENIC BACTERIOLOGICAL INVESTIGATIONS IN THE TISZA REACHES BETWEEN CSONGRÁD AND SZEGED (1975—1978)

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Abstract

In case of water utilization demanding the hygienic qualification of the surface waters, it is indispensable to carry out investigations for the quantitative and qualitative determination of the usual and facultative faecal indicator bacteria.

The authors performed investigations in the longitudinal section of the Tisza between Csongrád and Szeged, for establishing the hygienic bacteriological quality of the river and the change in pollution in time and space.

For the purpose of investigations, between 1975 and 1978, they took 440 water samples from the longitudinal section of the Tisza in County Csongrád and have carried out of this approximately 2700 investigations. The changes in the investigated hygienic bacteriological parameters are shown in figures and tables.

On the basis of results it was established that the hygienic water quality of the Tisza changed in a disadvantageous direction in the river stretch in County Csongrád between 1975 and 1978. The "somewhat polluted" water quality of the river became "polluted". The authors are calling the attention to that it is demanded by the protection of water quality, the administration of water quality, and by water utilization requiring a more and more increasing hygienic evaluation, that the river Tisza should be protected from further pollutions.

Introduction

In the Tisza valley, water is a factor of production which is only available in a minimum degree. 70 percent of the water requirement of the country presents itself here but only 20 percent of the water supply is to be found here. As it is known, only 3 percent of water flowing through the river-basin of the Tisza is of Hungarian origin. The other parts originate from the adjacent countries. In the following years, the quantity of foreign water curtailment increases prospectively more and more in our rivers and, owing to this, the water amount will decrease in this country. As the waters from the depth get more and more exhausted, as well, we must care for supplying the population with drinking-water of river origin. It is a known fact, too, that parallel with the increase in water demands, the amount of the issued sewage-water also increases (SIMÁDY 1977).

All these factors: the very changing and fluctuating water output of the Tisza, the sewage disposals of increasing volume, the construction of the Tisza river barrages strongly influence, change the microbiological conditions of river water.

In the last decade, more than one researcher dealt with investigating into the

Tisza. Longitudinal sectio ninvestigations were carried out by PAPP (1961, 1964) on the Tisza and its tributaries for a long time, of the results of which he rendered accounts in more than one publication. In his work: "Felszíni vizeink minősége" (Quality of our surface waters) (1965) he established on the basis of the investigated chemical and bacteriological parameters that the Tisza arrives clean in the country. The river suffers a major pollution in three places: at the mouth of the Sajó, as well as in the area below Szolnok and Szeged. He measured the maximum bacterial content below Szolnok (120,000/ml), the minimum below Szeged (220/ml).

At the same time, the values of the coliform count/ml reached 1.5—192. On the basis of average values, he found the water quality of the Tisza reaches at Szeged of class I (clean) above Szeged and of class II (a little poluted) in the reaches below the town.

In the summer period (VII—IX), in the Tisza reaches at Szeged, at 11 sampling sites, a detailed investigation was carried out by VETRÓ—KISS—MINDSZENTY (1966). On the basis of the results of the investigations, carried out for five years, they established that at the sewage disposals the value of coliform count in the Tisza water is unfavourable but the water quality of the places assigned for bathing is not endangered by these disposals. In the longitudinal section of the Tisza, Deák—Schiefer's investigations (1971) meant the first detailed survey, including both the bacteriological and biological parameters. It was shown by the results of the investigations, carried out by them, that the water quality of the Tisza became one category worse during the last ten years, i.e., the "clean" water quality became a little polluted. They have referred to, as well, that the microbiological conditions of the river will probably be changed by the Tisza II river barrage, then being in the course of construction. TAKÓCS—ANDRIK (1973, 1974, 1975) and ESTÓK—ANDRIK (1977) called the attention to the pollution of the Tisza stretch in Northern Hungary and of the tributaries, as well as to the pollution of these by pathogenic bacteria. ESTÓK—ANDRIK—CSÉPAI (1978) published the results of hygienic bacteriological investigations, registered in the Northern-Hungarian longitudinal section of the Tisza, after the Tisza II river barrage had begun functioning. They have established that the bacterial pollution of the Tisza had increased. Hegedűs—Kiss—Berényi, as mentioned in a former publication, reported on the salmonella contamination of the Tisza reaches in County Csongrád and of the two major tributaries. At present, we are demonstrating the changes in time and space and in quality of the investigated bacteriological parameters in the Tisza reaches between Csongrád and Szeged.

Materials and Methods

We have sampled the longitudinal section of the Tisza in County Csongrád (246—162.5 riv. km) from 1975, at six points, generally with a monthly frequency. Sampling sites are: Csongrád, pontoon-bridge 246.0 riv. km, Szentes, railway-bridge 242.0 riv. km, Mindszen', ferry 216.2 riv. km, Tápé, pontoon-bridge 176.5 riv. km, Szeged, open air bath 174.0 riv. km, as well as the area of Tiszasziget, 168—162.5 riv. km (Fig. 1). In 1978, our investigations increased. We could, namely, carry out cross-section investigations in the Hungarian—Jugoslav border-section, in order to register the effect of the outlet water from Szeged on the river reaches below the town.

The tributaries and major channels, discharging into the Tisza, were also systematically investigated in the past years. But we speak of these results only tangentially and report on them in detail in a later publication. For the purpose of investigations, 100 ml water samples were taken, 20 cm below the surface, from the streamline. The samples were brought, refrigerated, into the laboratory. They were processed there on the day of sampling but latest in 24 hours.

We have determined the bacterial count of coliform, faecal coliform, faecal streptococcus, resp. the streptococcus faecal, *Clostridium* and all the heterotrophic, psychrophilic, mesophilic bacteria.

The bacteriological investigations were carried out on the basis of the standard of the "Methodological Guide" (1977) and the "Bacteriological investigation into the drinking-water" (1971), published by the Water-hygienic Department of the National Institute of Public Health. The determination of the coliform and faecal coliform counts was made on the basis of the "most probable number (MPN)" principle in a lactose-bouillon culture medium. The cultures were incubated at 37 °C and 44°C for 48 hours. They were streaked from acid- and gas-containing test tubes on an endo-laminated culture medium. The lamellae were incubated at 37 °C for 24 hours, then the colonies of metallic

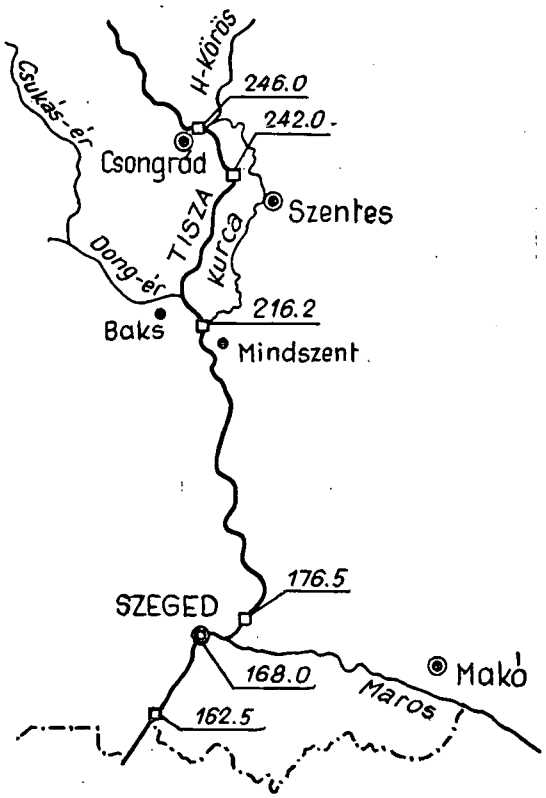

Fig. 1. Sampling sites in the Tisza reaches in County Csongrád (between 246—162.5 river kilometers).

lustre were evaluated. The heterotrophic bacterial count was determined in an agar culture medium with laminar casting method. The lamellae were incubated at 37 °C for 48 hours and at 20 °C for 96 hours. Then the colonies were counted. In 1975—1976, the streptococcus faecalis was determined in Litsky-Mallmann's culture medium with MPN method. The cultures were incubated at 37 °C, for 48 hours. The positive tubules were streaked on Szita's E^{67} laminar culture medium. Lamellae were placed into the thermostat at 37 °C for 24 hours, then the heat test was carried out at 60 °C for 30 minutes. From 1977, the bacteria belonging itoto the faecal streptococcus group were determined in Slanetz-Bartley's (M enterococcus agar) culture medium, with membrane filter. The clostridium count was determined in Wilson's bismuth-free glucose agar culture medium, incubated at 46 °C (±0.5 °C) for 24 hours.

At the hygienic water qualifications, the following indices were taken into consideration, according to the limiting values mentioned below, on the basis of Deák's data (1977). (Table 1).

Results

The results of the bacteriological investigations carried out in 1975—1976 are the following (Fig. 2): It can be established on the basis of the average values of the coliform count/ml that the water quality in the longitudinal section of the Tisza in County Csongrád changed unfavourably in 1976. In the areas of Mindszent and Tiszasziget, there was already shown a strongly polluted water quality of class IV by the maximum values. At the sampling sites of Csongrád and Szentes, the water quality of the Tisza belonged, on the basis of the hygienic water qualification, to the

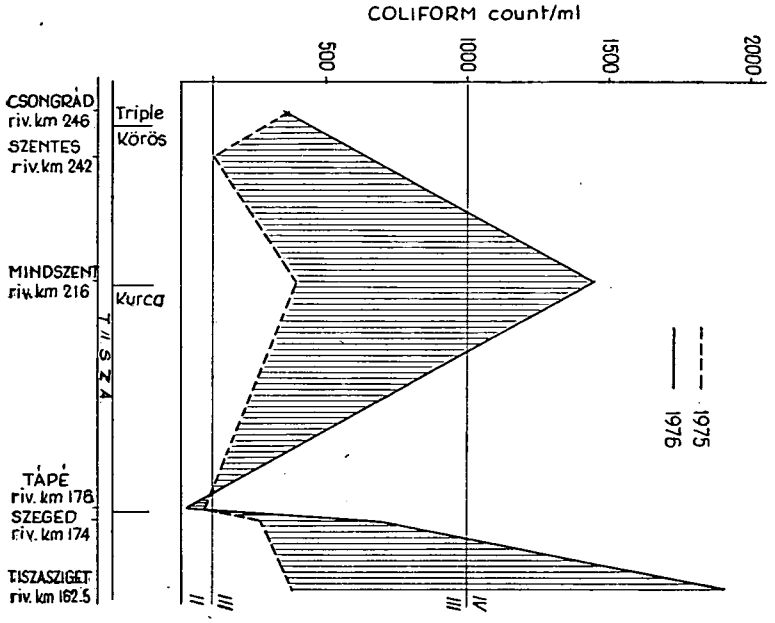

Fig. 2. Mean values of coliform count/ml at each sampling site in 1975—1976

polluted category III. In 1976, the most favourably water quality was to be found in the water area at Tápé of the longitudinal section of the river in County Csongrád. In this area, in annual mean value, the value of the coliform count/ml was below 100. Of the other investigated bacteriological parameters, the following can be said, in brief: They changed in the six water areas analysed so far similarly to the mean values of the coliform count. At the maximum of the coliform count, the other bacteriological parameters showed a maximum value, as well. In late July and early August, 1976, in the Jugoslav Tisza stretch, the Törökbecse river barrage began its trial operation. They began damming up the water without giving a previous information.

After it had become known to us that impoundment began, sampling was carried out more frequently for the purpose of bacteriological investigations between 168 and 160 river kilometers. The aim of the more frequent sampling was to be able to register the effect of impoundment in the boundary section. Then every investigated bacteriological parameter showed a maximum, as compared with the investigational results of the whole year.

As we can see from the water samples taken on 12 August (Fig. 3), the maximum

value of the coliform count was approximately 9000/ml. The value of the feacal coliform count is one order of magnitude lower than this. The values of the streptococcus faecalis and clostridium counts follow the tendency of the formers. After the vertical line, the data of the investigation of the cross-section are given.

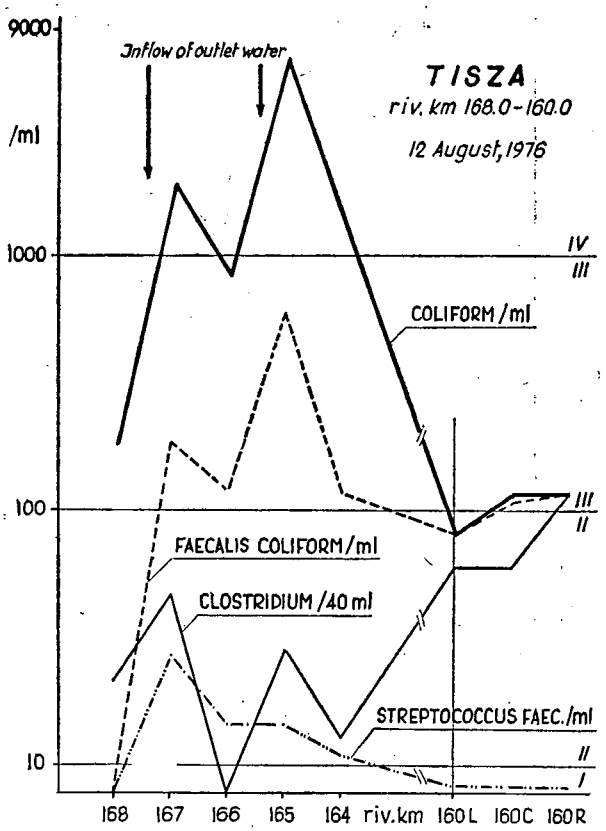

Fig. 3. Results of the bacteriological investigations into the water samples taken on 12 August, 1976.

I should like to observe that, in this time, the speed of the Tisza water was considerably slown down, showing almost the character of a standing water, and even, for a short time, it was flowing back. As damming began without any previous information, water speed could not be measured by the Water Conservancy of the Lower Tisza Region.

The bacteriological conditions of our water samples taken on 17 August (Fig. 4) are still more unfavourable. It is probable that in this time water speed continued slowing down and the local faecal indication could be measured well. The value of the coliform and faecal coliform count/ml was stagnant at a maximum between 1000 and 5000 between 167 and 164 river kilometers. In the same way, the streptococcus faecal count also stagnated at maximum.

The unfavourable change in the water quality of the Tisza may have been caused by several factors:

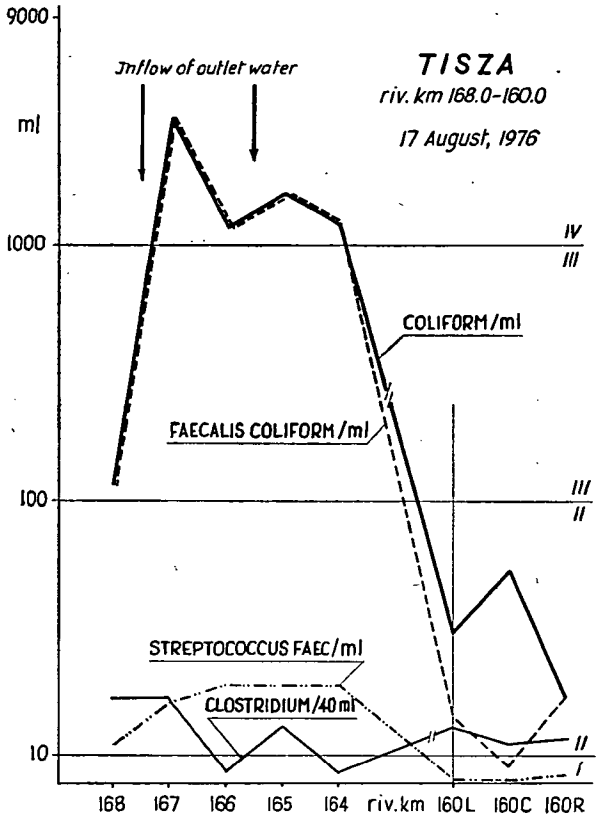

Fig. 4. Results of the bacteriological investigations into the water samples taken on 17 August, 1976.

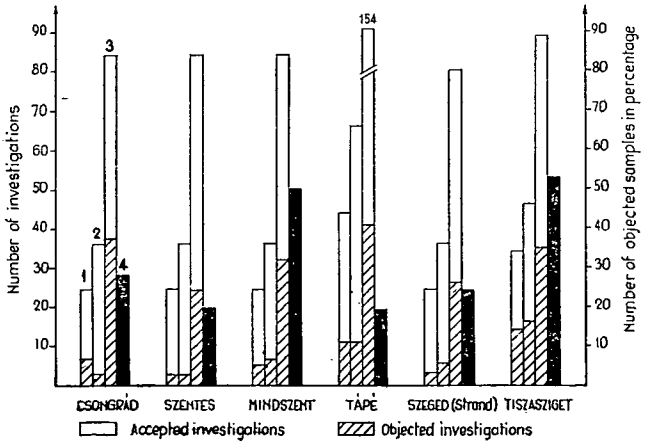

Fig. 5. Statistical evaluation of the results of the bacteriological investigations carried out in 1977 1 Number of investigations carried out for demonstrating heterotrophic bacteria 2 Number of investigations carried out for demonstrating E.coli 3 Number of investigations carried out for demonstrating other bacteria.

1) In the summer and autumn months, the water-level of the Tisza was very low.

2) In this time, the Tisza II river barrage already operated for three years.

3) The water quality of the Tisza was unfavourably affected in the area of Szeged by the polluted water quality of the Maros, as well.

4) In the Jugoslav Tisza stretch, damming began and the impoundment considerably changed the speed of the river in the area of Szeged.

About the results of the bacteriological investigations carried out in 1977, we are presenting here a statistical evaluation (Fig. 5). The number of investigations taken from different bacteriological parameters is given for each sampling site. Within the column, the accepted (light part) and the objected investigation numbers (shaded part) are indicated. In column 1, the investigations aimed at demonstrating the heterotropic bacteria (20 °C, 37 °C); in column 2, those of *E. coli* (coliform, faecal coliform, *E. coli* I.) bacteria are given; and in column 3, the number of other bacteriological (clostridium, faecal streptococcus and in colomn 4 Salmonella) investigations are shown.

The percentage of the objected samples is designated with a straight line.

On the basis of the statistical evaluation, it can be established that in 1977, similarly to 1976, the most unfavourable water quality in the longitudinal section of the Tisza was registered in the areas of Mindszent and Tiszasziget. But at the sampling site of Tápé a change followed in the water quality of the Tisza.

The values of the bacteriological investigations, carried out at the sampling site of Tápé in 1977, indicated a water quality of category III. For instance, the mean value of the coliform count/ml in 1977 was already 272, as opposed to 92/ml in the previous year.

As far as we know, there was no new introduction of a considerable quantity of outlet water in the vicinity of the sampling site. It is probable that the deterioration of water quality in the water of the Tisza at Tápé is a lasting result of the impoundment.

Table 1. *Limiting values of the hygienic water qualification*

Bacterological parameters	Categories of water qualification			
	I	II	III	IV
Coliform count/ml	0—10	10—100	100—1000	1000
Faecal coliform count/ml	0—1	1—10	10—100	100
Faecal streptococcus (Stanetz) count/ml	0—1	1—10	10—100	100
Streptococcus faecal count/ml	0	0—1	1—10	10
Salmonella positivity percentage	It can be demonstrated in a lower quantity than 33 p.c.			

On the basis of the hygienic bacteriological investigations in 1977, we can establish that the water quality of the Tisza is polluted (category III) at every sampling site in its longitudinal section in County Csongrád.

As the results of investigations in the past three years were most unfavourable at two sampling sites of the longitudinal section of the Tisza, in 1978 we systematically took water samples from the water of two channels, discharging into the Tisza at Mindszent. And in the Hungarian—Jugoslav boundary section of the Tisza, we have carried out cross-section investigations for ten months.

The Kurca is a channel of small water output, which collects the purified and not-purified outlet water of the town Szentes and flows, together with the Kórogyér, into the Tisza, at the left riverside (Fig. 1).

At the right bank of the Tisza, on the other hand, the Dongér Main Channel and the Csukásér, communicating with that, flow into the Tisza in the area of Mindszent. Their water quality is shown in a table (Table 2), compared with the water quality of the Tisza at Mindszent.

Table 2. *Mean values of the bacterial investigations in 1978*

Sampling site	Mean values			Water quality
	Coliform count/ml	Faecal coliform count/ml	*Clostridium* count/ml	
Csukásér Main Channel Tömörkény	48.000	4142	90	IV strongly polluted
Dongér Main Channel Baks	46.546	8087	326	IV strongly polluted
Kurca Below the town Szentes	1236	146	89.3	IV strongly polluted
Tisza Mindszent, riv. km 216	116.4	89.3	33.9	III polluted

The results are speaking for themselves. The water quality of the Dongér Main Channel at Baks, before discharging into the Tisza, is strongly polluted (category IV). The mean value of the coliform count/ml was 46546, that of the faecal coliform count/ml 8087. The value of the faecal streptococcus count reached 700/ml, and the clostridium count the value 800/40 ml.

The water quality of the Kurca channel was somewhat more favourable but similarly very polluted (category IV), on the basis of the investigated hygienic bacteriological parameters.

*

On the basis of the results of the hygienic bacteriological investigations into the longitudinal section of the Tisza in County Csongrád in 1975—1978, the following may comprehensively be established:

1) The hygienic water quality of the Tisza in the Tisza reaches of County Csongrád is polluted (category III).

2) The Tisza reaches at Mindszent (216. 2 riv. km) and Tiszasziget (162.5 riv. km) are considerably loaded by the introduced not-purified outlet water.

3) The water quality of the Tisza at Tápé (176.5 riv. km) deteriorated one category in the past two years, i.e., the water category, "polluted a little" became "poluted". The cause of this may be the putting into operation of the river barrage at Törökbecse. The registration of this fact, however, demands still further investigations.

4) As it is known, the river barrages built and functioning in the Tisza so far, have been constructed for the aims of water management and the economy of water-supplies. At the same time, we have to reckon with with the fact that the microbiological conditions of the river have been altered by the river barrages. Owing to impoundments, the river Tisza also becomes more and more a channel.

5) It is, therefore, required by the protection of water quality, the economy of water quality and the water utilization demanding a more and increased hygienic decision that the river Tisza should be protected from further pollutions.

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Higiénés bakteriológiai vizsgálatok a Tisza Csongrád és Szeged közötti szakaszán

HEGEDŰS MÁRIA, FODRÉ ZSÓFIA és ZSIGÓ MARGIT

Csongrád megyei Közegészségügyi és Járványügyi Állomás Szeged

Kivonat

Szerzők a Tisza említett hossz-szelvényében végeztek vizsgálatokat a folyó higiénés bakteriológiai minőségének, a szennyezettség tér- és időbeli változásának a megállapítására. Vizsgálataik a Tisza Csongrád megyei hossz-szelvényében 1975—78 között 2700 analízis alkalmazásával 440 vízmintára terjedtek ki. Megállapításaik során a vizsgált higiénés bakteriológiai paraméterek változását mutatták ki. Eszerint a Tisza higiénés vízminősége a Csongrád megyei szakaszon 1975 és 1980 között kedvezőtlen irányban változott. Így a folyó „kissé szennyezett" vízminősége „szennyezett"-té vált. Rámutattak, hogy a vízminőségvédelem és vízhasznosítás megköveteli, hogy a Tisza folyót a további zennyeződésektől meg kell óvni.

ГИГИЕНИЧЕСКИ-БАКТЕРИОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ ВОДЫ Р. ТИСА НА УЧАСТКЕ МЕЖДУ ЧОНГРАДОМ И СЕГЕДОМ

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Резюме

Авторами проведено исследование воды реки Тисы на указанном участке по определению её гигиенически-биологического качества, а также степени её загрязнённости в разных пространствах и в разное время. В ходе исследования в 1975—78 гг. продольного профиля Тисы в обл. Чонград было проведено 2700 анализов с 440 образцами воды. Как показывают определения, в исследуемых гигиенически-бактериологических параметрах наблюдались изменения. Установлено, что гигиеническое качество воды на участке обл. Чонград с 1975 по 1980 изменялось в неблагоприятном направлении. Имевшая ранее место оцена «несколько загрязнённая» изменилась на «загрязнённую».

Авторы указывают, что охрана качества воды и её использование требуют обязательного предохранения Тисы от дальнейшего загрязнения.

Sanitarno-bakteriološka ispitivanja na deonici Tise Csongrád—Szeged

Hegedűs Mária, Fodré Zsófia i Zsigó Margit
Zdravstvena i epidemiološka stanica Szeged

Abstrakt

Autori su na pomenutom uzdužnom profilu Tise vršili ispitivanja kvaliteta reke u odnosu na sanitarno-bakteriološka svojstva kao i utvrdjivanje promena zagadjenosti u prostornoj i vremenskoj funkciji. Na uzdužnom profilu reke u županiji Csongrád u toku 1975—78 izvršeno je 2700 analiza iz 440 proba. Pri ovim ispitivanjima utvrdjivane su promene u odnosu na sanitarno-bakteriološke parametre. Na osnovu toga je utvrdjeno da je u vremenu od 1975 i 1980 došlo do promene sanitarnoe kvaliteta vode Tise u negativnom smislu na deonici županije Csongrád. „Manja zagadjenost" jg postala „zagadjena". Autori ukazuju da zaštita kvaliteta vode i njeno korišćenje zahtevaju sprečavanje dalje zagadjivanje reke Tise.

Tiscia (Szeged) Vol. XV, pp. 45—51 (1980)

WEITERE VERGLEICHENDE BEITRAGE ZUR KENNTNIS LIMNOLOGISCHER VERHALTNISSE DER DONAU UND THEISS

ENIKŐ DOBLER und ANTAL SCHMIDT
Laboratorium für Wassergütekontrolle, Baja
(Eingegangen am 18 November, 1979)

Auszug

Die Verfasser vergleichen einige wasserchemische und hydrobiologische Eigenschaften Ungarns beider grössten Flüsse, der Donau und der Theiss. Die ersten vergleichenden Phytoplankton-Untersuchungen dieser Flüsse machte UHERKOVICH 1966—1967. Er bearbeitete eigentlich die quantitative und qualitative Zusammensetzung des Phytosestons der drei grössten Flüsse Ungarns und zwar der Donau, Drau und Theiss (UHERKOVICH 1969). Die hier veröffentlichten Daten stammen aus 1976—1977.

Die anorganischen chemischen Eigenschaften des Wassers beider Flüsse sind sehr ähnlich, fast gleich: relativ wenig gelöster, anorganischer Stoff und Ca—Mg—HCO_3 als dominierende Ionen.

Die durchgeführten hydrobiologischen Untersuchungen zeigen dagegen wichtige Differenzen: die Phytoplankton-Produktion ist in der Donau viel grösser (siehe: Algenzahl und Chlorophyll—A—Maximalwerte) und die saprobiologischen Verhältnisse — im Winterschlechter (siche: Pantle-Buck Indizes).

Diese Erscheinungen zeigen eindeutig eine grössere Abwasser-Belastung der Donau.

Material und Methode

Die Wasserproben stammen aus der südungarischen Strecke beider Flüsse: Donau, bei Baja, 1479 Strom-km; Theiss, bei Szeged—Tápé, 177.5 Strom-km. Es sind dieselbe Plätz wo UHERKOVICH seine Untersuchungen durchgeführt hat, nur 10 Jahre später, 1976—1977 (UHERKOVICH 1969).

Wir haben immer Schöpfproben bearbeitet: neben den wichtigsten wasserchemischen Messungen (pH. Leitfähigkeit, Ionen — nach KGST-Methoden) machten wir die folgenden hydrobiologischen Untersuchungen: qualitative und quantitative Zusammensetzung des Phytoplanktons, Chlorophyll—A Messung (653, 666 und 760 nm), saprobiologische Qualifizierung (nach PANTLE-BUCK).

Nach FELFÖLDY (1974) werden die Erscheinungen, die Eigenschaften de biologischen Wasserqualität in vier Gruppen eingeordnet:

1. *Halobität:* die anorganischen chemischen Eigenschaften des Wassers, die Gegebenheit der leblosen Umwelt (Ionen, gelöste anorganische Stoffe).
2. *Trofität:* die Fruchtbarkeit des Wasser-Ekosystems, die Stärke der Primärproduktion.
3. *Saprobität:* die Stärke des Abbaues, die Fähigkeit des Wasser-Ekosystems um organische Stoffe abzubauen.
   Trofität und Saprobität sind zusammenhängende, aber gegensätzliche Eigenschaften des Wassers.
4. *Toxicität:* die Fähigkeit des Wassers um Lebewesen zu vergiften oder ihre Lebenstätigkeit zu vermindern.

Ergebnisse und Diskussion

Charakterisierung des Donau- und Theisswassers aufgrund der obenangeführten Sortierung:

1. *Halobität:* die anorganischen chemischen Eigenschaften des Wassers beider Flüsse sind sehr ähnlich. Es beweisen auch die folgenden Daten:

	Donau	Theiss
Leitfähigkeit	300—600 uS (Es bedeutet gleichzeitig eine geringere Menge des gelösten Stoffinhaltes.)	250—500 uS
Dominierende Ionen	Ca—Mg—HCO_3 (im ganzen Jahr)	Juni—Sept.: Ca—HCO_3 sonst: Ca—Mg—HCO_3—SO_4

2—3. *Trofität und Saprobität*

Donau

Die zwei Kurven, die die saprobiologischen und Trofitätsverhältnisse widerspiegeln, sind mehr oder minder gegensätzlich. (Diese zwei verschiedene Datenreihen sind ihrer hydrobiologischen Informationsgehalte wegen — es bedeutet: sie zeigen numerisch die gegensätzlichen hydrobiologischen Erscheinungen, Prozesse — möglich zu vergleichen. Die PANTLE-BUCK-Indizes widerspiegeln die saprobiologischen Verhältnisse und die Chlorophyll-A Werte den aktuellen Trophiezustand.) Im Winter sind die saprobiologischen Erscheinungen im Vordergrund: es zeigt sich durch die höheren Werte des PANTLE-BUCK-Indexes ($S=3{,}00\pm0{,}20$; Saprobitätszustand α-mesosaprob) und die niedrigen, stagnierenden Werte des Chlorophyll-A Gehaltes. Abhängig von den hydrologischen und meteorologischen Verhältn issen aber meistens im März (oder im allgemeinen: wenn das Wassertemperatur auf 4—5 °C steigt und wenn die Zahl der Sonnenscheinigen Stunden monatlich die 100 Stunden erreicht) steigert sich die Phytoplanktonproduktion, die Algenzahl aufs mehrfachige. Später — also in der ganzen Vegetationsperiode — scheint es nur von der Wassermenge (bzw. Geschwindigkeit, Trübung) abhängig zu sein.

Die saprobiologischen Daten zeigen auch eine Veränderung der Wassergüte: die saprobiologische Kurve erstarrt sich in den Frühlingsmonaten ($S=2{,}50$) infolge der Massenproduktion von *Stephanodiscus hantzschii* GRUN. (Bacillariophyceae). Es bedeutet, dass nicht die saprobiologischen Probleme, sondern Trofitätsprobleme im Vordergrund sind. Und es ist in der ganzen Vegetationsperiode ähnlich ($S=2{,}30\pm0{,}20$).

Die Bedeutung der Wasserführung zeigt sich 1976—1977 gut, weil in diesen Jahren die Abflussverhältnisse gegensätzlich waren:

Im Frühjahr und Herbst 1976 war die Donau ziemlich niedrig (Q: weniger, als 2000 m^3/Sec) und so zeigt die Chlorophyllkurve mit zwei Gipfelpunkten in klassischem Format die Massenhaften Frühjahrs- und Herbstproduktionen von Centrales-Kieselalgen. In diesem Jahr war die Proportion der eutrophierten und eu- polytrophierten Zustände: 60,6%. Dagegen 1977 war die Donau schon im Februar, im ganzen Frühjahr und später auch im August ziemlich hoch (Q: über 3000 m^3/Sec). Es widerspiegelte sich natürlich im quantitativen Rhythmus des Phytoplanktons. Alle Frühjahrswerte von Chlorophyll-A waren unter 70

mg/m³ und nur dreimal im ganzen Jahr (Juli, Sept., Okt.) haben wir Chlorophyll-A über 100 mg/m³ gemessen.

In der Zusammensetzung des Phytoplanktons dominieren die Centrales-Kieselalgen und fast immer Stephanodiscus hantzschii. Weitere massenhaft vorkommende Centrales-Arten waren noch: *Melosira binderana* KÜTZ., *Stephanodiscus subsalsus* (CLEVE-EULER) HUST., *Stephanodiscus hantzschii* GRUN. var. *pusillus* GRUN. Weitere Centrales-Arten (*Cyclotella meneghiniana* KÜTZ., *Stephanodiscus astraea* (EHR.)

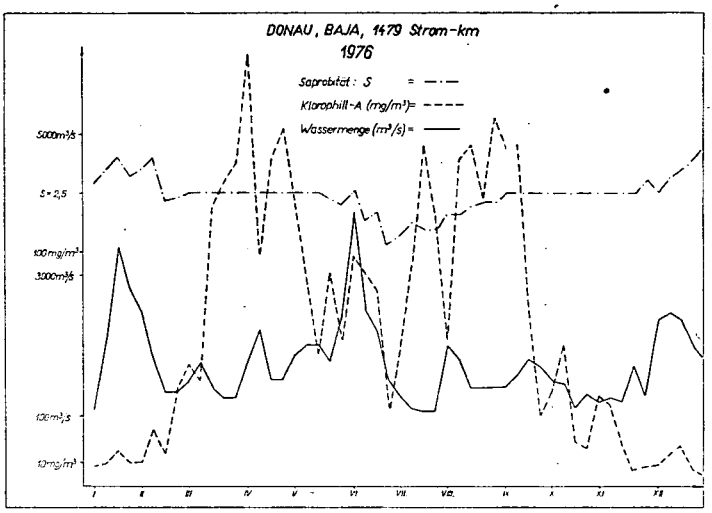

Abb. 1

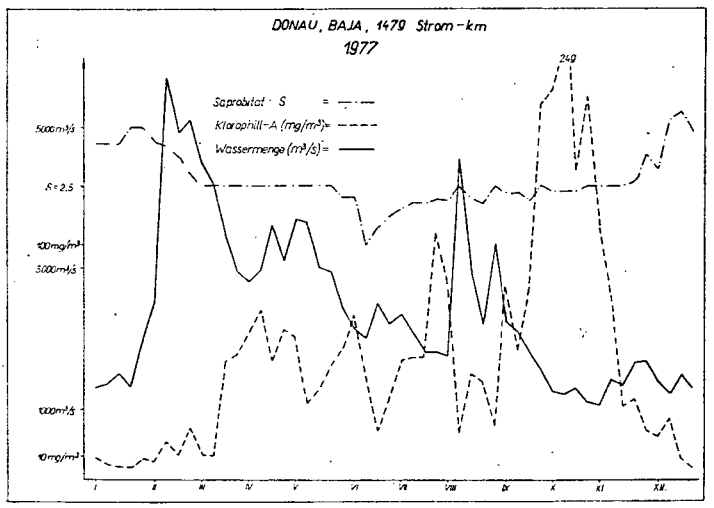

Abb. 2

GRUN., *Melosira islandica* O. MÜLL. ssp. *helvetica* O. MÜLL.), einige Pennales-Arten (*Asterionella formosa* HASS., *Diatoma elongatum* (LYNGB.)AG., *Diatoma vulgare* BORY, *Navicula gracilis* EHR., *Navicula viridula* KÜTZ., *Nitzschia acicularis* W. SM., *Synedra acus* KÜTZ., *Synedra ulna* (NITZSCH) EHR.) und die Chlorococcalen (*Scenedesmus* spp., *Ankistrodesmus* spp., *Dictyosphaerium* spp., *Actinastrum hantzschii* LAGERH.) sind immer nur subdominierende Mitglieder des Phytoplanktons.

Ein Vergleich zu UHERKOVICH' Daten zeigt eine mehrfachige Steigerung (cca. 10×) der Algenzahl und der qualitative Aspekt zeigt auch eine Veränderung: zur Zeit mehr *Stephanodiscus* statt *Cyclotella.*

Theiss

Die saprobiologischen Untersuchungen zeigen nichts besonderes: die PANTLE-BUCK-Indizes sind im ganzen Jahr unter S=2,50 (Saprobitätszustand: β- bis αβ-mesosaprob). Dass diese Werte auch im Winter so günstig sind, ist ein wichtiger Hinweis, dass dieser Fluss mit Abwasser weniger belastet ist, als die Donau.

Die Chlorophyllkurve zeigt 1976 kein Frühjahr-Herbst-Rhythmus. 1977ist es möglich zwei Gipfelpunkte (Chlorophyll-A: 15—20 mg/m³) zu erkennen. Diese relativ reichlichen Phytoplankton Gesellschaften können auch bei Niedrigwasserperioden (Q=300 m³/Sec) und auch bei Mittelwasserabflüsse (Q=1700 m³/Sec) vorkommen. Im allgemeinen: die Phytoplanktonproduktion der Theiss ist viel geringer, als bei der Donau. Trophiezustand der Theiss: mesotroph, bis meso-eutroph (vrgl. mit FELFÖLDYS Sortierung!). Die qualitative Zusammensetzung des Phytoplanktons

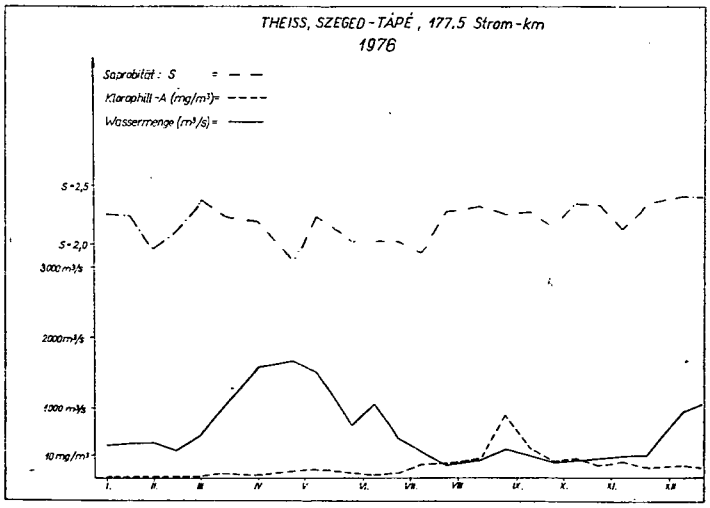

Abb. 3

verändert sich jede Jahreszeit. Im Winter sind in erster Linie Pennales-Kieselalgen zu finden (*Diatoma vulgare* BORY, *Diatoma anceps* (EHR. KIRCH., *Achnanthes minutissima* KÜTZ., *Asterionella formosa* HASS. *Asterionella gracillima* (HANTZSCH)HEIB., *Gomphonema olivaceum* (LYNGB.)KÜTZ., *Navicula cryptocephala* KÜTZ., *Navicula gregaria* DONK., *Nitzschia dissipata* (KÜTZ.)GRUN., *Nitzschia linearis* W.SM., *Nitzschia palea* (KÜTZ.)W.SM., *Synedra ulna* (NITSCH) EHR.). Die wichtigsten Centrales-Arten

dieser Zeit: *Stephanodiscus hantzschii* GRUN., *Stephanodiscus hantzschii* var. *pusillus* GRUN., *Melosira granulata* (EHR.) RALFS var. *angustissima* (O. MÜLL.) HUST.

Im Frühjahr erhöhert sich die Zahl dieser Algen und mit weiteren Algen aus verschiedenen taxonomischen Gruppen wird das Planktonbild abwechslungsreicher. (Chrysophyceae: *Chysococcus biporus* SKUJA, *Chrysococcus rufescens* KLEBS; Volvo-

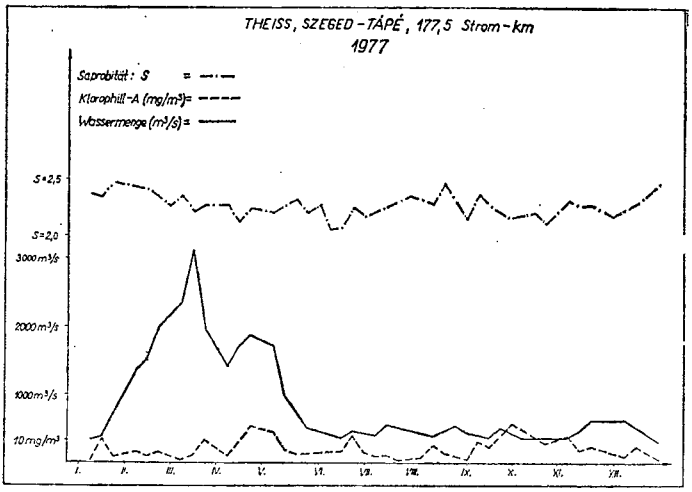

Abb. 4

cales: *Pteromonas* spp., *Chlamydomonas cingulata* PASCH., *Chlamydomonas ehrenbergii* GOROZ.; Chlorococcales: *Ankistrodesmus* spp., *Dictyosphaerium ehrenbergianum* NAG., Euglenophyta: *Trachelomonas hispida* (PERTY) STEIN, *Trachelomonas volvocina* EHR.).

Im Sommer (Aug.) und Herbst sind *Melosira distans* (EHR.) KÜTZ., *Nitzschia actinastroides* (LEMM) v. GOOR, *Stephanodiscus subsalsus* (CLEVE-EULER) HUST. die dominierenden Mitglieder des Phytoplanktons.

*

1. Diese zusammengleichende Tabelle zeigt die Maximalwerte des Phytoplanktons:

	1966—1967 (nach UHERKOVICH 1969)	1976—77
Donau	6 479 000 Ind/1	98 400 000 Ind/1
Theiss	4 170 000 Ind/1	22 700 000 Ind/1

2. Die beiliegenden Diagramme zeigen die jahreszeitlichen Veränderungen des PANTLE-BUCK-Indexes und Chlorophyll-Inhaltes in Zusammenhang mit dem Wasserlauf.

3. Ausser den zusammenfassenden Arbeiten aus den 60-er Jahren (SZEMES 1967.: Donau und UHERKOVICH 1971.: Theiss) enthalten die folgenden Publikationen aus den 70-er Jahren, meist qualitative Daten zur Kenntnis des Phytoplanktons

der ungaraländischen Donau- und Theiss-Strecke: HAMAR, — 1974. HORTOBÁGYI 1974, 1975, 1979,. SCHMIDT 1976, 1978, UHERKOVICH—SCHMIDT—VÖRÖS 1975., TEVANNÉ, B. É. 1978.

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További összehasonlító adalékok a Duna és a Tisza limnológiai viszonyainak ismeretéhez

DOBLER LÁSZLÓNÉ és SCHMIDT A.

Alsó Tisza-vidéki Vízügyi Igazgatóság Szeged;
Alsó Dunavölgyi Vízügyi Igazgatóság Baja

Kivonat

Szerzők Magyarország két legnagyobb folyójának egyes vízkémiai és hidrobiológiai tulajdonságait hasonlították össze. A vízminták a Dunából Bajánál (1479 folyam km) a Tiszából Szegednél (177,5 folym km) kerültek begyűjtésre. A két folyó vizének szervetlen kémiai tulajdonságai nagyon hasonlóak. Jellemző a viszonylag kevés oldott ásványi anyag és a Ca—Mg—HCO_3 ion-dominancia. — Ezzel szemben a hidrobiológiai vizsgálatok (mennyiségi és minőségi fitoplankton-elemzés, klorofill—A mérés) lényeges különbséget mutatnak: a Duna fitoplankton produkciója lényegesen nagyobb és a szaprobiológiai viszonyok (Pantle-Buck-index alapján) télen rosszabbak. Ezek a jelenségek egyértelműen a Duna nagyobb szennyvíz telítettségére utalnak.

НОВЫЕ СРАВНИТЕЛЬНЫЕ ДАННЫЕ ДЛЯ ИЗУЧЕНИЯ ЛИМНОЛОГИЧЕСКИХ УСЛОВИЙ ДУНАЯ И ТИСЫ

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Резюме

Авторами проведено сравнение химических и гидробиологических свойств воды двух крупнейших рек Венгрии. Водные образцы Дуная были взяты в районе г. Байа (1479 р. км), а Тисы — в районе г. Сегед (177,5 р. км). Неорганическихимические свойства воды двух рек очень подобны. Характерным является сравнительно небольшое содержание растворимых минеральных веществ и доминирование ионов Ca—Mg—HCO_3. В то же время гидробиологические анализы (количественный и качественный анализ фитопланктонов, измерение хлорофила—А) свидетельствуют о значительных расхождениях: фитопланктонная продукция Дуная значительно больше, а сапро- биологические условия (на основе индекса Pantle-Buck) зимой здесь хуже. Эти явления представляют явное подтверждение большей загрязнённости воды Дуная.

Dalji uporedni prilozi limnoloških svojstava Dunava i Tise

Dobler László né i Schmidt A.
Vodna uprava donjeg toka Tise Szeged; Vodna uprava donjeg toka Dunava Baja

Abstrakt

Autori su uporedjivali pojedine hemijske i hidrobiološke osobine dve najveće reke Madjarske. Probe su uzimane kod Baje iz Dunava (1479 rečni Km) i kod Szeged-a iz Tise (177,5 rečni Km). Neorganska hemijska svojstva obe reke su veoma slične. Karakteristična je relativno mala količina rastvorenih minerala i dominacija Ca—Mg—HCO_3 iona. Nasuprot hidrobiološka ispitivanja (kvantitativna i kvalitativna analiza fitoplanktona i hlorofila A) dala su bitne razlike: Dunav daje srazmerno veću fitoplanktonsku produkciju. Takodje su i saprobiološki odnosi (po indeksu Pantle-Buck) zimi pogoršani. Ove pojave jednosmisleno ukazuju na veći stepen zagadjenosti Dunava.

Tiscia (Szeged) Vol. XV, pp. 53—59 (1980)

О ВОДНОЙ РАСТИТЕЛЬНОСТИ СРЕДНЕГО ТЕЧЕНИЯ РЕКИ ТИСЫ И ЕЕ ПРИТОК

В. И. КОМЕНДАР, С. С. ФОДОР

Река Тиса образуется от лияния двух рек: Чорной Тисы (берет начало на горе Окола 1245 м н. у. м.) и Белой Тисы (начало на Черногоре, 1500 м н. у. м.). Слияние этих двух рек происходит вблизи города Рахово. Длина Тисы в пределах Закарпатья составляет 260 км (от горы Окола до города Чоп). Длина среднего течения в пределах Закарпатья боолее 95 км (от с. Теково до города Чоп). К бассейну реки Тисы относятся более 20 рек и 900 потоков.

В среднем течении. с левой стороны в пределах Закарпатья в Тису впадает только Ьатар, берушая начало на Гутинских горах. Другие ее притоки с левой стороны — Тур и Самош, вытекаюшие с Роднайских гор вливаются в Тису на территории ВНР. С правой стороны, в пределах Закарпатья, в среднее течение реки Тисы впадают в начале река Боржава, вытекаюшая с Ьоржавских полонин, далее реки Латорица и Уж, берушие начало в Водораздельных Карпатах (Восточных Бескидах).

Согласно данных О. Р. Довганя (1973), минерализация воды Тисы в среднем течении составляет 186 мг/л, а обшая твердость достигает 8°. В воде на этом месте содержится значительное количество сульфатов.

В литературе имеются только упоминания об отдельных высших водных растениях или об их сообществах бассейна реки Тисы. (Фодор, 1965, Комендар, Фодор, 1966 и некоторые другие работы). Нам не известна ни одна публикация по водорослям этой реки.

Изучение водных растений реки Тисы имеет не только практическое, но и немалое научное значение, поскольку до сих пор значительно уменьшилось количество водных растений, а некоторые ценозы являюстя редкими или исчезаюшими и требуют охраны.

С 1964 года начались нами работы по изучению как водных растений, так и фитопланктона среднего течения реки Тисы в Ужгородском и Ьеретовском районах. (При определении фитопланктона была получена консультация и помошь старшего научного сотрудника Института гидробиологии АН УССР, О. П. Оксинюк).

Прежде всего рассмотрим высшие водные растения, произрастаюшие в старицах Латорицы в Ужгородском районе.

Одна из этих стариц образовалась в виде водоема ("озера") на правом берегу р. Латорицы.

Неглубокий зарастающий водоем глубиной до 50 см, дно оторфованное. Высшая водная растительность размещена тут поясами: пояс береговой растительности с видами *Myosotis palustris* L;, *Galium palustre* L., *Ranunculus lingua* L., *Juncus effusus* L., *Scirpus silvaticus* L., *Typha angustifolia* L., *Rorippa amphybia* (L.) Bess., *Eleocharis palustris* (L.) R. Br. s. l., *Carex elongata* L., *C. pseudocyperus* L., *C. vesicaria* L., *C. riparia C. flava* L., *Glyceria aquatica* L.

Водоем зарос до 50 %. В нем выявлены такие водоросли, как *Phacus orbicularis* Hübner, *Scenedesmus bijugatus* (Turp.) Kütz., *S. b.* var. *alternans* Kütz., *S. acuminatus* (Lagerh.) Chod., *S. a* var. *Biseriatus* Kütz., *Dactyosphaerium pulchellum* Wad., *Pediastrum tetras* (Ehrb.) Ralfs., *Staurastrum apucalatum* Breb., *S. paradoxum* Meyen, *Closterium parvulum* Nag., *Mougeotia* sp., *Coelastrum microporum* Nag., *Merismopedia punctata* Meyen., *Trachelomonos volvocina* Corda:, *Ankistrodesmus acicularis* Korschik., *A. falcatus.* Ralfs., *Oscillatoria limosa* Ag., *Gomphosphaeria lacustris* Chod., *Navicula cryptocephala* Kütz., *N. rynchocephala* Kütz., *N. radiosa* Kütz., *N. mutica* Kütz., *N. gracilis* Kütz., *Cymbella cuspidata* (Kütz.) Grum., *C. cistula* (Hemp.) Grum. *C. cimbiformis* (Kütz.) V. H., *C. tumidula* Grum. *Gyrosygma acuminatum* Kütz., *Diatoma vulgare* Bory., *Nitzshia dissipata* (Kütz.) Grun., *N. recta* Hantzsch., *N. punctata* (W. Sm.) Grun. *Fragillaria virescens* Ealfs., *Amphora ovalis* Kütz.

Второй водоем такого происхождения расположен здесь на левом берегур. Латорицы. Площадь его 150 м², глубина воды — 1—1,5 м, с илистым дном. Высшие водные растения размещены в нем в поясах:

Пояс береговой растительности с видами: *Tyhpha angustifolia* L. *Juncus effusus* L., *Scirpus lacustris* L.; прибрежный пояс с видами: *Carex vesicaria* L., *C. vulpina* L., *C. riparia* Curt., *Eleocharis ovata* (Roth.) R. et Sch., *Alopecurus geniculatus* L., *Glyceria aquatica* Wahl. Пояс растений с плавающими листьями: *Batrachium trichophyllum* Bossche, *Potamogeton pectinatus* L., *P. natans* L., *Stratiotes aloides* L. пояс подводных растений; *Utricularia vulgaris* L., *Myriophyllum spicatum* L., *Ceratophyllum demersum* L., *Typha angustifolia* L., *Sagittaria sagittifolia* L. Зарастание водоема высшими водными растениями составляет 35 %. В водоеме найдено такие виды водорослей, как *Pediastrum tetras* (Ehrb.) Ralfs., *Staurastum apiculatum* Breb., *Cosmarium granatum* Bréb., *C. ahtotes* Nordst., *Staurastum paradoxum* Meyen., *Collastrum microporum* Nag., *Merismopedia punctata* Meyen., *Phacus orbicularis* Hübner., *Ankistrodesmus acicularis* Korschik., *A. falcatus* Ralfs., *Oscillatoria limosa* Ag., *Surirella angustata* Kütz., *Eunotia lunaris* (Ehr.) Grun., *Raphalodia gibba* Var., *R. ventricosa* Grun., *Synedra biceps.* (Kütz.) Schonf., *Meridion curcularа* (Grev.) Ag., *Nacicula hungarica* Grun., *N. gastrum* Ehr., *N. scutus* (Schum.) V. H., *Cymbella gracilis* (Rabenk.) Cl., *C. lata* Grun., *C. Ehrenbergii* Kütz., *C. navi culiformis* Auresw., *C. turgida* (Greb.) Cl., *Nitzshia intermedia* Hantsch., *N. vermicularis* (Kütz.) Grun., *N. angostata* (W. Sm.) Grun., *N. dubia* W. Sm., *Pinnularia microstauron* (Ehr.) Cl., *Synedra tabulata* (Ag.) Kütz., *Gomphonema olivaceum* (Lyngb.) Kütz., *Cocconeus pediculus* Ehr., *C. angustata* Kütz., *Surirella ovata* Kütz.

Здесь на правом берегу р. Латорицы, водоем глубиной 1—1,5 м дает снование развития следующим водным растениям. На береговом поясе: *Leucojum aestivum* L., *Myosotis palustris* (L.) With., *Scirpus lancustris* L., *Juncus filiformis* L., *Sparganium polyedrum* (Ach. et. Gr.) Juz., *Typha angustifolia* L., *Rorippa austriaca* (Caratz.) Bess., *Galium palustre* L. на прибрежном поясе *Ranunculus flammula* L., *Eleocharis ovata* (Roth.) R. et. Sch., *Carex riparia* Curt., *C. vesicaria* L., *Alisma plantago-aquatica* L. Пояс растений с плавающими листьями *Batrachium trichophyllum*

Bossche, *Potamogeton* пояс подводных растений: *Utricularia vulgaris* L; *Hottonia palustris L.* Доминирует *Typha angustifolia* L. Зарастание высшими растениями водоема составляет около 30 %. В водоеме выявлено такие виды водорослей: *Pediastrum tetras* (Ehrh.) Ralfs., *Phacus caudatus* Hübner., *Closterium parvulum* Nag., *Nitzschia sigmoidea* (Ehr.) Ralfs., *N. anglica* Ralfs., *N. palea* (Kütz.) W; Sm., *N. intermedia* Hautsch., *N. vermicularis* (Ehr.) Cl., *Gyrosygma Kuetzingii* (Grun) Cl., *G. acuminatum* (Kütz.) Rabenk, *Navicula seuteloides* W. Sm., *N. Cryptocephala* Kütz., *N. gastrum* Ehrk; *Pinnularia tabellaria* Ehr., *Eunobia robustra* Ralfs., *Epitemia zebra* (Ehr.) Kütz., *Cymatophleura solea* (Ehr.) Kütz., *Synedra capitata* Ehr., *Oxillatoria tenuis* (Woronich) V. Poljansk., *Fragilaria construens* Ehr., *Oxillatoria tenuis* (Woronich) V. Poljansk., *Fragilaria contruens* (Ehr.) Grun., *Gymphonema olivaceum* (Lyngb.) Kütz., *Scenedesmus quadricanda* Brid., *Diatoma vulgare* Bory., *Synedra tabulata* (Ag.) Kütz., *Cymbella parva* (W. Sm.) Cl., *Coconeis pediculus* Ehr., *Achnanthes affinis* Grun., *Gomphonema constriotum* Ehr., *Cyclotella Menenghiniana* Kütz., *Surirella angustata* Kütz., *S. ovata* Kütz., *Melosira varians* Ag., *Ankistrodesmus falcatus* (Corda) Ralfs., *Trachelomonos volvocina* Ehr.

На другом месте по этому же берегу Латорицы в водоеме глубиной 1,5—2 м, по береговому поясу ис высших водных растений находим произрастание: *Leucojum aestivum* L., *Galium palustre* L., *Ranunculus pseudobulbosus* Schur., *Juncus effusus* L., *Typha angustifolia* L., прибрежном поясе; *Ranunculus flammula* L., *Eleocharis ovata* (Roth.) R. et. Sch., *Carex riparia* Curt., *C. elongata* L., Alisma plantago-*aquatica* L., в поясе растений с плавающими листьями; *Batrachium trichophyllum* Bossche, *Potamogeton nutans* L., *P. pectinatus* L., *Nuphar luteum* L.. в поясе подводных растений; *Utricularia vulgaris* L., *Myriophyllum spicatum*, Доминирует *Nuphar Luteum* L. Покрытие высшими растениями составляет около 50—60 %. В водоеме выявлены такие водоросли, как *Navicula cryptocephala* Kütz., *N. mutica* Kütz., *N. radiosa* Kütz., *N. gastrum* Ehr., *N. scutus* (Schum.) V. H., *Cymbella cuspidata* Kütz., *Gyrosigma acuminatum* Kütz., *Diatoma vulgare* Bory; *D. elongatum* (Lyngb.) Kütz., *Scenedesmus bijugatus* Bred., *S. acuminatus* Bred., *Pediastrum tetras* Ralfs., *Closterium parvulum* Nag., *Cosmarium granatum* Bred., *C. undulatum* Corda, *Gomphonema acuminata* Kütz., *G. olivacum* Kütz., *Dacryloccapsis avicularis* Lemm., *Dermocarpa aquedulcis* Geitl., *Pandorina morum* Bory., *Navicula oblonga* Kütz., *Lyngbia nigra* Ag., *Cymbella cistula* Grun., *C. lacustris* (Ag.) Cl., *C. aspera* (Ehr.) Cl. *Nitzschia recta* Hantsch,. *N. dubia* W. Sm., *N. amphibia* Grun., *N. grecilus* Hantsch., *Fragillaria virescens* Ralfs., *Synedra capitata* Ehrb., *Oscilatoria tenuis* V. Poljansk.

В. И. Комендар, С. С. Фодор в своих работах за 1964 и 1966 гг. приводят данные о распространении редчайших в Закарпатье водных папоротников — марсилии и сальвинии.

Кроме описанных в этом месте растительных сообществ с участием марсилии в водоеме "Малый Битриц" (окраина села Малых Ратовцев), были здесь описаны также ассоциации; *Nymphaea alba+Potamogeton natans+Marsilia quadrifolia,* и *Sparganium neglectum+Marsilia quadfolia.* В этом же водоеме была обнаружена довольно редкая и интересная ассоциация *Schoenoplectus lacustris* (L.) Palla.

Доминирующими являются здесь ассоциации с *Nymphaea alba* L. *Nuphar luteum* (L.) Sibt. et Sm. и с участием редчайшей *Nympheoides peltata* (S. Gmel.) Kuntze.

Заросли марсилии и сальвинии найдено и в водоемах каналов Чаронда —

Тиса, Чаронда — Латорица, вблизи села Яворова, а также в каналах вблизи с. Великой Доброни (Ужгородского района).

На пруду Цирипа возле моста в окрестностях села Великие Геевцы найдена ассоциация с *Trapa natans* L. Интересным оказался водоем в окрестностях с. Великих Геевцев, в котором преобладает *Potamogeton fluitans* Roth., *P. pusillus* L. на его берегу *Limosella aquatica* L. единственное пока место произрастания этого растения в Закарпатье. Вместе с этим видом здесь произрастают и такие растения, як *Myosurus minimus* L., *Calitriche stagnolis* Scop., *Juncus ambiquus* Guns., *J. bufonius* L., *Eleochraris acicularis* (L.) R. et. Sch., *Peplis portula* L., *Rorippa palustris* (Zeyss.) Bess., *Ranunculus lateriflorus* D. C.

На заболоченной почве в урочище Чаронда в окрестностях села Демичева описана ассоциация *Stratiotes aloides* L. с растениями *Cicuta virosa* L., *Sagittaria sagittifolia* L., *Pragmites communis* Trin., *Epilobium palustre* L., *Salvinia natans* All. и некоторые другие.

В Береговском районе одном из наиболее богатом в флористическом отношении является канал Верке, который пересекает западную часть района и берет начало из речки Ьоржавы около села Доброселье, а впадает в канал Серне. Канал Верке был выкопан в конце XIX — в начале XX веков. Ширина его 7—8, иногда 15 м, глубина — 1,5—2 м, скорость течения — 20 м/сек.

На берегу канала густые заросли образует *Glyceria fluitans* (L.) R. Br. прибрежный пояс образуют *Glyceria fluitans* (L.) R. Br., *Ranunculus flammula* L. *Butomus unbellatus* L., *Carex flava;* и другие. Водное зеркало занимают растения с плаваюшими листьями: *Nuphar luteum* (L.) Sibth. et Sm., *Potamogeton natans L., P. crispus* L. *Polygonum amphybium* L. под водой иногда встречаются: *Najas marina* L., *N. minor* All., *Myriophyllum spicatum* L., *Ceratophyllum demersum* L., *Vallisneria spiralis* L.

Канал Серне, проходячий через Черное болото на севере, берет начало возле села Гута и впадает в Латорицу. Ширина его — 10—15 м, глубина — до 4,5 м. На берегу значительные площади занимают сообшества с *Phragmites communis* Trin., *Typha latifolia* L. Прибрежная растительность представлена видами: *Alisma plantagoaquatica* L., *Sagittaria sagittifolia* L. и др. Среди плаваюших по воде растений можно встретить густые заросли *Hydrocharis morsusranae* L. вперемежку с которыми встречаются сообшества *Salvinia natans* All., *Lemna minor* L., *L. trisulca* L., *Spirodella polyrrhiza* L. Schleid.

В середине водоема довольно большие площади занимают сообшества *Nuphar luteum*+*Trapa natans.*

Много водных растений встречается в речке Боржава, которая в окрестностьях села Боржавы образует несколько стариц. Часть из них летом высыхает, а часть достигает глубины 3—4 м, в которых вода чистая и прозрачная. На берегах этих водоемов в большом количестве встречается *Typha angustifolia* L., *Phragmites communis* Trin., *Juncus effusus* L., *Scirpus lacustris* L. прибрежная растительность представлена такими видами, как *Lythrum salicaria* L., *Ranunculus repens* L., *R. flammula* L., *Myosotis palustris* Lam., *Glyceria aquatica* (L.) Wahlb., *Butomus umbellatus* L., *Sagittaria sagittifolia* L., *Iris pseudacorus* L., *Galium palustre* L., *Carex vulpina* L., *C. vesicaria* L., *Mentha verticillata* L. и др.

Пояс растений с плаваюшими листьями представлен *Nymphaea alba* L., *Trapa natans* L., *Utricularia vulgaris* L., *Potamogeton crispus* L. которые образуют соответственные сообшества.

В болотных местах в зоне дубовых лесов в урочише Чизай среди кустарников найдено *Dryopteris thelypteris* A. Gray.

Ниже приводим список высших водных и прибрежных растений по экологическим группам, обнаруженные нами в среднем течении реки Тисы и ее притоков в пределах Закарпатья.

Гидатофиты: *Potamogeton pectinatus* L., *P. pusillus* L., *P. lucens* L., *P. obtusifolius* MERT. et KOCH., *P. gramineus* L., *P. perfoliatus* L., *P. natans* L., *P. crispus* L., *Stratiotes aloides* L., *Hydrocharis morsus-ranae* L., *Utricularia vulgaris* L., *Myriophyllum spicatum* L., *Trapa natans* L., *Ceratophyllum demersum* L., *C. submersum* L., *C. platycanthum* CHAM., *Nymphaea alba* L., *Nuphar luteum* (L.) SIBTH. et SM., *Nymphoides peltata* KUNTAL., *Menyanthes trifoliata* L., *Gallitriche stagnalis* SCOP., *Najas minor* ALL., *N. marina* L., *Lemma minor* L., *L. gibba* L., *L. trisulca* L., *Hottonia palustris* L., *Hippuris vulgaris* L., *Batrachium aquatile* DUM., *B. fluitans* WIMM., *Salvina natans* ALL.
Всего 31 вид.

Гидрофиты: *Sagittaria sagittifolia* L., *Alisma plantago-aquatica* L., *A. gramineum* GMEL., *Butomus umbellatus* L., *Sparganium polyedrum* A. et GR., *S. simplex* HUDS., *S. erectum* L., *Limosella quatica* L., *Elatine alsinastrum* L., *Typha latifolia* L., *T. angustifolia* L., *Acorus calamus* L., *Scirpus lacustris* L., *S. sylvaticus* L., *Schoenaplectus Tabernaemontani* (GMEL.) PALLA. *Heleocharis acicularis* (L.) R. BR., *H. pauciflora* (LIGHTH.) LINK., *Phragmites communis* TRIN., *Marsilia quadrifolia* L.
Всего 19 видов.

Гигрофиты: *Caltha palustris* L., *Ranunculus pseudobulbosus* SCHUR, *R. flammula* L., *R. lingua* L.,*Cardamine pratensis* L., *C. impatiens* L., *C. amara* L., *Rorippa amphybia* BESS., *R. palustris* BESS., *Stellaria palustris* RETZ, *Malachium aquaticum* FR; *Rumex maritimus* L., *R. aquaticus* L., *Polygonum amphibium* L., *P. persicaria* L., *P. minus* HUDS., *P; hydropiper* L., *Filipendula ulmaria* MAX., *Comarum palustre* L., *Potentilla anserina* L., *Geum rivale* L., *Sanguisorba officinalis* L., *Euphorbia palustris* L., *E. virgata* W. K., *Epilobium palustre* L., *E. hirsutum* L., *E. parviflorum* SCHREB., *Onagra biennis* SCOP., *Lysimachia punctata* L., *Gratiola officinalis* L., *Veronica longifolia* L., *V. scutellata* L., *V. onagallis* L., *V. aquatica* BERNH., *V. beccabunga* L., *Elatine hungarica* MOESZ., *Lathyrus palustris* L., *Myosotis palustris* L., *Symphytum officinale* L. *Scutellaria galericulata* L., *S. hastifolia* L., *Mentha aquatica* L., *M. silvestris* L., *Galium mollugo* L., *G. palustre* L., *Succisella inflexa* (KLUK). BECH., *Helianthus decapetalus* L., *Bidens cernuus* L., *B. tripartitus* L., *Senecio aquaticus* HUDS., *S. paludosus* L., *S. fluviatilis* WALL., *Cirsium palustre* SCOP., *C. canum* (L.) M. B., *Sonchus oleraceus* L., *Crepis biennis* L., *Hieracium virosum* PAL., *Alnus glutinosa* (L.) GAERT. *A. incana* (L.) MÜNCH., *Salix alba* L., *S. fragilis* L., *S. triandra* L., *S. purpurea* L., *S. cinerea* L., *Populus nigra* L., *P. alba* L., *Leucojum aestivum* L., *Iris pseudocorus* L., *Juncus effusus* L., *J. filiformis* L., *J. inflexus* L., *J. bufonius L., Eleocharis ovata* (ROTH.) ROEM. et SCHULT., *Carex vulpina* L., *C. elongata* L., *C. vesicaria* L., *C. riparia* CURT., *C. cyperoides* L., *C. limosa* L., *C. pseudocyperus* L., *C. acutiformis* EHRH., *Glyceria aquatica* WAHL., *G. fluitans* L., *G. plicata* FR., *G. nemoralis* UECHT. et KORN., *Beckmannia eruciformis* HOST., *Baldingeria picta* (L.) NUM., *Calamagrostis pseudophragmites* BAUMG., *Poa palustris* L., *Catabrosa aquatica* (L.) P. B., *Alopecurus geniculatus* L., *Leersia oryzoides* (L.) SWART.

Результаты исследований водных растений среднего течения реки Тисы и ее притоков показали, что преобладающее большинство растений являсютя обычными водными растениями умеренного поясакосмополитами типичными для всех водоемов и рек. Обрашают однако на себя внимание такие виды, как *Marsilia quadrifolia* L., *Salvinia natans* L., *Utricularia vulgaria* L., *Schoenoplectus tabernaemontani* PALLA, *Comarum palustre* L., *Veronica longifolia* L., *Elatine hungarica* MOESZ., *Helianthus decapetalus* L., *Baldingeria picta* (L.) NUM., *Catabrosa*

aquatica (L.) R. B. и др., которых следует охранять, как редкие, ценные для науки виды. Охране подлежат и все водоемы, части рек, где образуются сообщества водных растений, поскольку большинство из них играют большую роль в биологической очистке воды.

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A Tisza középfolyásának és mellékfolyóinak vízinövényei

KOMENDÁR V. és FODOR I.

Kivonat

E közlemény megírásában az a cél vezetett minket, hogy bemutassuk a Tisza középfolyásának (Kárpátontúli terület, SZSZK) és mellékfolyóinak (Batár, Borzsava, Latorica, Uzs) víziflóráját és víznövényzetét.

Bemutatjuk a tanulmányozott terület álló és lassúfolyású vizeinek (holtágak, csatornák, folyók, lápok, mocsarak) lebegő vagy rögzített alámerült vagy felszínen elterülő flóráját és növénytársulatait (moszatokat, hínárokat). Azonkívül ismertetjük az ottani partmenti, mocsári és lápréti magaskórós vegetációkat is, a káka, nád, gyékény, szittyó, sás és egyéb vízinövények elterjedését.

Különösen figyelmet fordítottunk a Vérke és a Szernye csatornák jelenleg megmaradt flórájára és növényzetre, az ott védett *Marsilea Quadrifolia* L. *Salvinia natans* (L.) ALL, *Elatine hungarica* MOESZ., *Catabrosa aquatica* (L.) P. B., stb. életviszonyaira és elterjedésére.

Több éves kutatásaink eredménye szerint a Tisza középfolyásának és mellékfolyóinak területén található virágos vízinövények között 31 faj hidátofita, 19 faj hidrofita és 86 faj higrofita.

Az emberi tevékenység hatására erősen változó tiszai környezet szükségessé teszi ezeknek a vízinövényeknek további kutatását, gazdasági felhasználását és védelmét.

Vodene biljke srednjeg toka Tise i njenih pritoka

KOMENDAR V. i FODOR I.

Abstrakt

U saopštenju autori prikazuju vodenu floru i vegetaciju srednjeg toka Tise (Zakarpatsko područje SSSR) i njenih pritoka (Batar, Boržava, Latorica, Už). Prikazuje se lebdeća i ukorenjena, površinska i potopljena flora i biljne zajednice stajaćih i sporotekućih voda (alge i drezge) ispitivanog područja. Takodje se prikazuje i priobalna, močvarna i ritska makrotska vegetacija (trska, rogoz itd.).

Posebna pažnja je posvećena još prisutnoj flori kanala Vérke i Sernje u odnosu na rasprostranjenje i životne uslove zaštićenih vrsta *Marsilea Quadrifolia* L., *Salvinia natans* (L.) ALL., *Elatine hungarica* MOESZ., *Catabrosa aquatica* (L.) P. B., itd.

Na osnovu višegodišnjih istraživanja utvrdjeno je da se na području srednjeg toka Tise i njenih pritoka od vodenih cvetnica nalaze 31 hidatofitna, 19 hidrofitnih i 86 higrofitnih vrsta.

Vidne promene područja Tise pod antropogenim uticajemiziskuju dalja floristička istraživanja u smislu korišćenja i zaštite vegetacije.

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THE ROTATORIA FAUNA OF THE FLOOD-PLAIN OF THE BODROG AT SÁROSPATAK

I. BANCSI

(Received 30, September, 1976)

Abstract

It is an indispensable part of becoming acquainted with a river, to study also its tributaries and the water areas (stagnant water, dead arms, borrowing pits), getting into a seasonal connection with it. The fauna-composition of the Bodrog, and through that the composition of the Tisza fauna, as well, are considerably influenced by the rich Rotatoria fauna of the Bodrog-flood-plain in the period of floods. In springtime, we have to reckon with the planktonic species, in Autumn with the metaphytic species getting into.

Introduction

In the course of investigating the Rotatoria fauna of the Tisza systematically, in respect of both the qualitative and the quantitative data, the effect of the tributaries and from time to time that of their flood-plain, too, can be observed well. The investigation of the tributaries and of the surfaces of the flood-plain belongs closely to studying the Tisza. Valuable investigations were carried out in several areas of the water system. The Rotatoria of the dead-arms of the Tisza are known on the basis of Mrs. Székely's (1954) and Megyeri's works (1961), the fauna of the borrowing pits, on that of Varga's works (1928 to 1930). The results of the investigations of tributaries were published by MEGYERI (1972). From among the dead-arms of tributaries, we have some data only on two dead-arms of the Körös (VARGA 1931). The investigation of the dead-arms and borrowing pits of the Bodrog was carried out by me In 1967—1970. On the oxygen-carbon-dioxide circulation, water-chemical conditions, floristic and faunistic studies of the water-surfaces investigated, a few earlier publications (DÉVAI et *al.* 1969—1970, DÉVAI et *al.* 1971, DÉVAI *et* al. 1972—1973) were giving some informations. Apart from the faunistic elaboration, I was striving to complete my work more and more with aetiological and ecological observations, as well.

Materials and Methods

My investigations were performed in the flood-plain of the Bodrog at Sárospatak—Végardó, between 1967 and 1970. The dead-arm of the Bodrog, the rivulet Füzes-ér, and the borrowing pits along the four dams were investigated systematically.

The Bodrog dead-arm (Paptava) was separated in the time of the regulations, in the years 1860 to 1870. The depth of water is on average 1.5 to 2 m (max. 3 m), breadth is between 80 to 100 m. The

riverside zone, after a narrow, shallow strip suddenly deepens. The water is of b-limno-Ca-HCO_3 type, its pH is 7.05—8.30, the total saline content was between 190—250 mg/l. In the place of the investigation, a 25 to 30 m broad saligot stand (*Trapetum natantis* MÜLLER-GÖRS) of 70 to per cent cover extended. An open-water surface can only be found in the middle, 8 to 10 m broad, streak of the dead-arm. In addition to the predominant saligot, there occurred the rough pool-weed (*Ceratophyllum demersum* L.), and water-soldier (*Stratiotes aloides* L.).

The rivulet Füzes-ér was, in the time of the investigations, the remainder of an ancient canal filled in, and being here and there swampy. In an about 0.8 ha area, the water depth is generally 0.6 to 15 m, but in a small part of the area there occurs a depth of 3.5 to 4.0, as well. The Füzes-ér is connected with the dead-arm of the Bodrog by a narrow canal. The water is here of b-limno-Ca-HCO_3 type, pH 6.5—8 1, total saline content 195—245 mg/l. The extremely rich reed-grass and uliginal vegetation growing here enables the Rotatoria fauna of the various plant-stands to be investigated.

The characteristic associations were the water-soldier hair-weed (*Hydrochari-Stratiotetum* LANGENDOCK (WESTHOFF), the saligot (*Trapetum natantis* MÜLLER-GÖRS) and the association of the reed-grass and water-spike (*Polygono-Potametum natantis* Soó). Among the assocations mentioned there were also mingled sporadically some elements of bladder-wort and duckweed (*Lemno-Utricularietum* Soó), as well as of water-fern (*Salvinio-Spirodeletum* Soó). At the northern fringe a thinly-scattered stand was formed by the great bulrush (*Schoenoplectus lacustris* PALLA). In the shallow marshy areas the marshy bulrush (*Eleocharis palustris* L. & f SCH.), the arrow-head (*Sagittaria sagittifolia* L.), and the "flower"-bulrush (*Butomus unbellatus* L.) were the stand-formers. (I am giving here the characterization of the macrovegetation by using Gy. Dévai's paper of 1972).

The brownish water of the four borrowing pits investigated and independent of one another was, similarly to the former ones, of b-limno-Ca-HCO_3 type. The muddy bottom of the borrowing pits was thickly covered by leaves fallen from the trees of the protective forest.

For investigating the Rotatoria fauna of the Bodrog dead-arm and the Füzes-ér, we have collected some samples from the physiognomically different parts of both areas. From the borrowing pits, there was only dipped out one sample on every occasion.

From the Bodrog dead-arm, the samples were collected out of seven places: at the riverside (A/1), at the open-water fringe with saligut 20 cm below the surface (B/1), at the vicinity of the bottom (B/2), at the middle of the open water from the surface (C/1), at the middle region of water (C/2), and near the bottom (C/3).

From the Füzes-ér, our samples were collected on occasions out of eleven places of different vegetation. Eight sampling sites (1, 2, 3, 4, 5, 6, 7, 8) were in places of different vegetations, while three of them (9/1, 9/2, 9/3) were in the layers of different depth (surface, middle, bottom) of the medial, open-water area of the Füzes-ér.

Our investigations began in the Summer of 1967. The first time only investigations of gathering information were carried out in order to establish how far the area is suitable for a systematical recording series. In 1968, on the basis of samples collected from the sampling sites appointed of the Bodrog dead-arm, the migration of the Rotatoria fauna in the part of the day was investigated at two dates differring in their meteorological conditions (from June 30 to July 1, and from July 6 to 7). For following the supposed vertical migration, we took samples in every six hours (02^{00}—08^{00}, 14^{00}, 20^{00}, 02^{00}). The systematical investigation of the Bodrog dead-arm and the Füzes-ér started in 1969 (IV.26, V.10, VI.23, VII.25, VIII.19., IX. 10), and was completed in 1970 (III.14). The fauna of the borrowing pits was studied on the basis of the samples taken on the days VI.22, 1969, III.4, V.5, VI.23, and VIII.28.

For quantitative investigations, the filtrate of 5 l water filtered through a 53 μ mesh net of 25 I/A quality was used. The living samples were systematically investigated, as well. Fixation took place with 37 per cent formalin. For studying living animals, Lidocain solution was used.

Taxons are denominated according to M. Voigt's taxonomical handbook.

Rotatoria fauna of the water mater surfaces of the flood-plain

The enumeration of the species found in the course of investigations is contained in a comprehensive paper dealing with the water surfaces of the flood-plain (DÉVAI *et* al. 1972, 1973). In the following I am treating of the species occurring in a higher individual density and being remarkable in ecological respect. At characterizing the species, I am dwelling on the data of their occurrence in this country and the comments of ecological reference by other authors, as well.

Anuraeopsis fissa (GOSSE)

It is regarded as in euplanktonic, "warm-stenothermous" animal (VARGA 1945), but it was occasionally collected from water-weeds, as well (VARGA 1945). In the waters of this country it is ubiquitous; in the dead-arms (MEGYERI 1965), in minor standing waters (MEGYERI 1965), and the waters of bogs (MEGYERI 1969) it occursa like.

In the dead-water Paptava it was found in sampling places C/3, resp. C/2, on July 21 and August 19, 1969. In the borrowing pits it was not found.

It was collected from all the sampling sites of the Füzes-ér. In sites 5, 7, and 8, the multiplication rhytm of the species was showing some similarity to those observed in he open water (9), while in the other sampling sites it was different from these. Its multiplication maximum — that took place in September, at 13 °C water temperature — it was most express in open water.

It was supposedly a result of the mass production at site 9 that, later on, it appeared as a dominant species in every sampling place in the midst of plants (except for site 5).

Its mass occurrence in Autumn in the Füzes-ér and its rapid early-spring multiplication observed in the borrowing pits at Sóstó (in April, at 14 °C water temperature) (BANCSI 1970), then its disappearance, as well as its presence observed in the Paptava at deep summer sampling sites are showing a good accord with the statement of PEJLER (1961) and VARGA—DUDICH (1939) that in the summer month it occurs in the deeper layers of the water. From this the conclusion can be drawn that *Anuraeopsis fissa* is not expressly a summer "warm-stenothermic" species but a planktonic organism preferring the colder waters of about 13 °C temperature, found in the spring and autumn months.

Ascomorpha saltans Bartsch

A species widely distributed in the plankton of smaller or larger waters, found occasionally in algal coatings (VOIGT 1956). It is rare in faunas, known only from a few places (VARGA 1941). It was found in the stagnant water of the Bodrog, on June 30 — July 1, 1968 in a low individual number but only July 6—7 1968 in large numbers, in a water of nearly 25 °C temperature. Taking this into consideration, we have to designate the temperature limits of the presence of the species in 2.3 to 25 °C, instead of the 2.3 to 19.4 °C, measured by FINDENEGG (1953).

In the Füzes-ér, on May 10, 1969, a considerable number of them were found at sampling sites 5 and 8. The later disappearance of the species is probably caused by the expansion of the reed-grass vegetation submerged.

Aspanchna priodonta GOSSE

It is a frequent member of the plankton of smaller or larger standing waters (VOIGT 1956), being present in large numbers from time to time. In our waters — in dead-arms, fish-ponds, saline waters (DADAY 1891, 1892, 1894, 1896, KERTÉSZ 1894, MEGYERI 1960, 1961, VARGA 1932, 1945) — it is generally present. It is a eurythermous (VARGA 1938; FINDENEGG 1953), eurytopic species (AURICH 1933), present in the course of the whole year. In the course of our samplings, it proved to be one of the dominant plankton-organisms of the Paptava and Füzes-ér.

On June 30 and July 1, 1968, in the stagnant water — supposedly owing to the unfavourable weather conditions — it was only present in a quite low individual

number. On July 6—7, however, we have already collected it in a more than twenty-fold amount, as compared to the previous occasion. The extremely intensive reproductivity of Asplanchna priodonta is proved by the quick change in its endividual number.

It was found in the course of our samplings in 1969 almost on every occasion, primarily in the plankton, but — taking into consideration its size and predacity, too — mainly in the spring months, it is a considerable member of the metaphyton, as well. Its presence in the early-spring plant-covered places does not preclude our establishment, achieved by reason of our observations in the standing water, as the macrovegetation is in that time (April, May) still very undeveloped.

Two maxima of its reproductive cycle were observed; the one of these in May (at 18.4 °C water-temperature in the standing water, resp. 19 °C in the Füzes-ér); and another in July (at 20 °C, resp. 20.2 °C water temperature). The temperature values measured by us agree well enough with the data of B. Pejler (1961) who had observed the reproductive maxima of the species in month VI at 15 °C, and in month VIII at 20 °C water temperature. It is obvious that a mass production of the species is primarily depending not on the season but on water temperature.

Brachionus angularis GOSSE

It is a frequent species in our shallow waters, often being present in large numbers (VARGA—DUDICH 1939). It is primarily a dweller of free banks (DADAY 1891) but is also to be found in midst of water-plants (DADAY 1891), in the plankton of standing waters (MEGYERI 1965), and in river-waters (GÁL 1963).

In 1968, there were found only a few individuals. In 1969, on the other hand, a large enough number of theirs could be collected in the Paptava during the whole year, in the Füzes-ér in the spring months.

In the stagnant water of the Bodrog, two reproductive maxima were observed: one of them in Spring and the other in Autumn what agrees with M. Voigt's statement (1956) well. On the intensity of species propagation the presence of some algal species *(Chlorella, Chlamidomonas)* has a positive, while that of others *(Synura)* a negativ influence (POURIOT 1965). Its disappearance from the Füzes-ér, as well as the summer fall in the individual number in the mortlake and the regression of the maximum of autumn multiplication may have been, in our case, a result of the major multiplication of *Synura uvella.*

Brachionus calyciflorus PALLAS

In the waters of our country it is a frequent enough species, often being present in large numbers (VARGA—DUDICH 1939). It occurs in dead-arms (MEGYERI 1961), in the reed- and reed-grass-covered bank-zone of the saline waters (DADAY 1894) and small waters alike (DADAY 1892).

It can generally be found in the months May—June and September in large individual numbers (VOIGT 1956). In the standing water of the Bodrog it could only be found in April, but in a very small individual number.

Brachionus calyciflorus var. *dorcas* (GOSSE)

Not too frequent in our fauna, it can be found sporadically in smaller standing waters (DADAY 1885, 1892), and dead-arms (MEGYERI 1961).

It was collected from sampling sites 4, 6, 7, and 9/2, in the spring months. In open

water it was present in considerably larger individual numbers than in the places covered with macrovegetation, from what the planktonic course in life of the species can be concluded.

Brachionus falcatus ZACHARIAS

This species is rather rare in our fauna, and was only collected on a single occasion, on August 19, 1969, from the open-water (9) sampling places of the Füzes-ér. The open water is specified as the biotope of the species by the literary data in this country, as well (MEGYERI 1961, 1965). Taking into consideration the masterly construction of its carapace — that is a fine example of the accomodation to the planktonic way of life — this seems to us understandable enough, as the free motion of the species in the midst of the vegetation would be made almost impossible by the strongly elongated and curved spikes.

Brachionus quadridentatus HERMANN

It is a species living in small waters, in the plant-covered in shore region of lakes (VOIGTN 1956).

In our fauna it is frequent. It was found among the vegetation of major standing waters (VARGA 1945), in saline waters (DADAY 1894), and in morassic waters (MEGYERI 1965) alike. It is considered by MEGYERI (1969) as a characteristic marshland species.

According to VOIGT (1956), it has three multiplication maxima (spring, summer, autumnal ones). From these, in 1969, only the summer "running up" (till July 21st) was observed in the ox-bow lake. In the spring months, not even a single individual of the species was found. In the sampling of June 23, however, there were found a great many individuals with 2 to 4 eggs.

The extremely rapid reproductive faculty of the species, and the existence of its summer multiplication maximum were supported by our investigations in 1963, as well: while namely on June 30 and July 1, 1968, only a few individuals of it could be found in various points of the section, a week later — on July 6—7 — during the day 230 individuals were collected, primarily from sites B/1, B/2, and C/2. The influence of weather on the formation of the Rotatoria fauna is unequivocally proved by the difference between the data of the two sampling points of time, as well. In the open-water and plant-covered surfaces of the Füzes-ér, it was only found in the summer months, in a comparatively small individual number.

It is shown by our investigations, that the presence of the forms of *Brachionus quadridentatus* can be used for denoting the total salinity of waters: In the waters of high total salinity *e.g.*, in the natron lake Sóstó at Nyíregyháza (BANCSI 1970), and in other saline waters of the Great Hungarian Plain, the varieties of the species with short dorsal spines — var. *latissimus,* and var. *rhananus* — as well as the variety cluniorbicularis without dorsal spines occur, in the waters of lower total salinity, on the other hand (for instance in the marshy waters — Lake Baláta: 75 mg(l—), the form with long dorsal spines is dominant.

Cephalodella exigua (GOSSE)

It is a rare species in the Hungarian fauna, demonstrated so far only from Lake Balaton and its environment (VARGA 1941, 1945, 1957).

In the course of our samplings, it could only be found at sampling site 1, on a single occasion, in small individual numbers.

Cephalodella serrata WULFERT

It was collected at sampling sites 1 and 2, on March 4, 1970. It seems to be a ubiquitous species in the Carpathian Mountains and in Northern Europe (BARZINS 1967), as a dweller of the shallow, cold waters.

Cephalodella rotunda WULFERT

It was found in the Füzes-ér, in the winter samples taken from sampling sites 5 and 6 (March 4, 1970), in rather small numbers.

This species may supposedly be found in the cold waters richer in decomposing organic matters.

Colurella adriatica (EHRB.) (Picture 10)

It is frequent enough in the fauna of our country but in large individual numbers it is only present rarely (VARGA—DUDICH 1939). It was demonstrated from plankton (VARGA 1931), the surface of mud (ENTU—KOTTÁSZ—SEBESTYÉN 1937), among water-plants (VARGA 1939), from *Cladophora* network (VARGA 1941), in the midst of *Ceratophyllum* and *Hydrocharis* (VARGA 1945), from marshy waters (MEGYERI 1965, 1969), and from among the psammon of Lake Balaton (VARGA 1957) alike. On the basis of the data of its occurrence, the species may be classed among the eurytopic organisms.

It was found in the Füzes-ér, at any sampling site designated among plants. In the summer months, its individual density was higher than in the autumnal-winter and spring months. This is supposedly referring to that for a considerable multiplication a comparatively higher water temperature is also demanded by the species, apart from the presence of the vegetation.

Our establishment of the eurytopic character of the species is supported by its occurrence in all the plant associations. In the Bodrog stagnant-water, it was present in the riverside zone grown by plants richly.

In the borrowing pits it was not found, what may be explained univocally by a complete lack in a higher vegetation.

The presence of macrovegetation or an algal network, or possibly of both, may be regarded — taking into consideration the literary data, as well — as one of the important conditions of the occurrence of Colurella adriatica.

Colurella obtusa (GOSSE)

This species, occurring in the detritus, algal network, psammon, and among water-plants alike, has so far been known only from Lake Balaton and its environment (VARGA 1938, 1939, 1941, 1945, 1957).

In the Füzes-ér, it was found in the samples from September 25, at sampling site 2. The species is of southern distribution. Its presence in NE-Hungary seems therefore to be an interesting datum.

Colurella uncinata (O. F. MÜLLER)

It lives in waters rich in organic detritus, in the riverside zone of the waters covered richly by plants. In our waters it is a very common species (DADAY 1893, 1895, 1892, 1896, 1897, KERTÉSZ 1894, MEGYERI 1961, VARGA 1932, 1938, 1939, 1945, 1957, ENTZ—KOTTÁSZ—SEBESTYÉN 1937), casually occurring in large numbers (VARGA 1931, VARGA—DUDICH 1939).

In the Füzes-ér, it was found at any sampling site. Its multiplication maximum was observed at site 8 in July, and at the other sampling sites in August. The two maxima demonstrated at site 7 are striking.

The species is almost quite indifferent to the qualitative composition of vegetation. This is proved by that it occurred at any sites — except for that No. 6 — in a similar individual density.

On June 30 and July 1, 1968, it was found in the Paptava but in a small number. On July 6—7, on the other hand, more than four-fold of the individual number found on the previous occasion were collected. It was primarily found in the fringe at the bank, more rarely at sampling point C/3, in the open water. In 1969, it was collected but on July 21, at sites A/1 and C/3.

In spite of that the species was found at site C/3 even on more occasions, its presence in the plankton cannot be regarded as characteristic. In our case, its presence at site C/3 may be explained by the comparatively higher amount of the organic tripton there.

Conochilus unicornis ROUSSELET

It is a wide-spead species, being to be found in the plankton of smaller and larger waters, generally in the course of the whole year (VOIGT 1956). In the waters of this country it is not frequent.

In the plankton of the Füzes-ér it was only found in the months May and June, in a considerably smaller individual number, as compared to the individual density observed at the other sampling sites. In the spring period (April, May) it lived rather one by one, while in the summer months in colonies of 15 to 20.

At sites among plants, the maximum of the individual density was observed at dates differring from one another: thus, at sites 4, 5, and 6 in May, at sites 1, 2, and 8 in June, and at site 3 in July. The multiplication maxima observed in the months May and July correspond to the phenological rhythm of the species (BANCSI 1970), and the smaller maxima in June may have been given from the temporal postponement of the distribution of the species.

In the stagnant water, it was found both in plankton and metaphyton from Spring to Autumn. Here two multiplication maxima were observed.

Dicranophorus epicharis HARRING-MYERS

It is a new species in our fauna. It is a species wide-spread in the whole world, with sporadic presence (BERZINS 1967).

In the Füzes-ér, it was collected in a quite small number, in April and August.

The animal carries on a predatory way of life so much so that for instance *Trichocerca, Bdelloidea,* and *Cephalodella* mastaxes were found in the content of intestines. The animal can be recognized well, even if the determination was carried out from a sample fixed.

Dipleuchis daranuoatpll (GOSSE)

It is a wide-spread species of sporadic presence, living in muddy pools and bog-waters (VOIGT 1956).

In this country, it was primarily found in bog-waters — in the bogs at Zsombó (MEGYERI 1969) and Bátorliget (VARGA 1953) — and in the waters of the Hanság (VARGA 1935). In the Füzes-ér, it was found in small individual number at some

sampling sites of a character differring from one another, namely at site 2 on July 21, at site 3 on August 19.

Epiphanes clavulata (EHRB.) (Picture 1)

Our experiences concerning the species agree with the literary data (VOIGT 1956) completely, both in respect of organizational peculiarities and of the data of occurrence.

In the Füzes-ér, they were collected in small individual number, in months August and September.

From among the borrowing pits along the dam, at sampling site R/3 it was already found in July. Its individual density was considerably higher as compared to that observed in the Füzes-ér.

Epiphanes senta (O. F. MÜLLER)

It is regarded as a wide-spread species (VOIGT 1956), but in the fauna of our country it is rare (VARGA—DUDICH, 1939). The origin of the latter statement may have been that it can only be found in large numbers in the spring months and, therefore, it was collected but rarely (VARGA—DUDICH, 1939). This opinion is confirmed by Gy. Dévai's data (1970), as well.

In the spring months, on April 26 and May 10, it occurred both in the Paptava and the Füzes-ér.

Euchlanis dilatata (EHRB.)

It occurs in large numbers among water-plants (VARGA 1939, 1945), in algal covers and often in planktons (DADAY 1897, VARGA 1932), as well (VOIGT 1956). It is common in the smaller and larger standing waters, dead-arms, bog-waters in this country (DADAY 1883, 1885, KERTÉSZ, 1894, ÁBRAHÁM—BENDE—HORVÁTH—MEGYERI 1952, 1954, ÁBRAHÁM—BICZÓK—MEGYERI 1961, 1965, 1969).

Its appearance in large numbers may be expected, according to B. Carlin's data (1943), from July to November, at 15 °to 20 °C water-temperature.

In 1969, its presence in the Paptava was rather unsystematical. In the months May, August, and September it was mainly collected in the parts near the riversides.

In the Füzes-ér it was found at any sampling sites — designated among the plants. In spite of its systematical occurrence here, there has not been observed any multiplication maximum.

On two occasions, at sampling place 1, the form-variety var. lucksisna Hauer 1930 was also found.

Euchlanis lyra HUDSON

This species, occurring but very seldom in our fauna, lives among water-papers (VARGA 1939). It was only collected at sampling site 8, on several occasions but in very small individual number.

Filina longiseta (EHRB.)

It is a euplanktical (VARGA 1932), cosmopolite species (VARGA 1931, VARGA—DUDICH 1939), to be found in smaller standing waters (MEGYERI 1965), dead-arms (MEGYERI 1961), saline waters (DADAY 1894), river-waters (GÁL 1963), and rain-water pools (Spandl 1926) alike.

According to O. SEBESTYÉN (1953), it generally occurs in larger individual numbers in eutrophic waters.

The temperature data of the habitat of the species are highly manifold: the temperature limits of its occurrence were located by I. FINDENEGG (1953) between 2.7 and 21.7 °C. L. VARGA (1928) regards it as a summer form, and G. ENTZ—O. KOTTÁSZ-SEBESTYÉN (1937) as cold stenothermous. In the course of our summer collections in 1968, they were only found in a small individual number.

In April, May, and June of 1969, they were found in large numbers in the mortlake. On the other occasions, however, it was only collected in small numbers.

In the Füzes-ér, in the spring months — April and May — it was found in a considerable number at any sampling sites. After the expansion of the macrovegetation, anyway, the presence of the species was limited but to the open-water, where in month August even another multiplication maximum was developing.

On the basis of its conditions of occurrence in the waters of the flood-plain, it is to be regarded as a spring-autumnal form of Filinia longiseta.

Filinia passa (O. F. MÜLLER)

syn. *Filinia mystacina* (EHRB.)

It was found in the plankton of lakes and in small mud-pools (VOIGT 1956).

In our fauna it is frequent enough. It was found by S. BARTSCH (1877) in the vicinity of Baja, and mentioned by K. KERTÉSZ (1894) in the fauna of the environment of Budapest, by L. VARGA (1928, 1930) in the borrowing pits along the Tisza at Szeged and (1934) in Lake Fertő.

In 1969, as a member of the spring and early-summer fauna, it was found by us in the mortlake in considerable numbers. From the samples of July and August it did not come to light but at the sampling on September 25 we again found it in the plankton. This species, too, will probably prove to be a spring-autumnal form.

Keratella cochlearis (GOSSE)

It is a euplanktonical, cosmopolite, eurytopic species, rich in forms and to be generally found in the smaller and larger standing waters in our country.

From among its forms, in the course of our collections, there were found its forms named var. *macracantha,* f. *typica,* f. *micracantha,* var. *tecta,* f. *connectens,* var. *angulifera,* f. *pustulata,* and f. *hispida,* found even together in the period of the multiplication maxima.

In the Bodrog-standing-water and the Füzes-ér, it was generally found in large numbers, and casually even in masses. From the borrowing pits it was only found in No. R/1, in a very small individual number.

In the course of samplings in 1969, in the Paptava and the Füzes-ér, two multiplication maxima of the species were observed. These anyway developed in the two places in a different way from one another. The first "running up" — represented by a different individual density in the two water-areas — was observed in May, the second maximum in the dead-arm in September and in the Füzes-ér in July and August. In the Füzes-ér, there was produced by the summer multiplication maximum more than three times as high an individual density as in the Paptava. It is absolutely worth mentioning that the maximum was most express in the places where in Summer a rich macrovegetation grew.

The Füzes-ér is less exposed to the rinsing effect of floods and, therefore, a considerable part of the detritus disturbed there is left over after the marching down of

flood-waves, offering a favourable feeding possibility to the detritophagous species. In the mortlake, the situation is similar with the difference that the flood washes away a large part of the organic detritus. Accordingly, it becomes understandable that in May *Keratella cochlearis* is present in the Füzes- ér in larger individual numbers than in the Paptava, because the former one is providing, besides the planktonical way of life, for the more favourable food conditions.

In bringing about the open-water maximum in the late Summer, early Autumn, a considerable part is also played by the large mass of organic tripton washed in from the riverside zone.

Keratella cochlearis is, therefore, a plankton-organism, the appearance of which in large numbers is very favourably influenced by the quantity of the organic detritus.

Keratella quadrata (O. F. MÜLLER)

It is a cosmopolite, euplanktonical species. They are to be found in the plankton of smaller or larger standing and fresh waters (VOIGT 1956), casually among water-vegetation (VARGA 1941). In larger waters it may be present in large numbers, as well (VARGA—DUDICH 1939). In our country, together with its form-varieties, it can mostly be collected during the whole year. It is a species of wide ecological valence: it was equally found in saline waters (DADAY 1894), bog-waters (MEGYERI 1965, 1969), dead-arms (MEGYERI 1961), small waters in the mountains (ÁBRAHÁM—BICZÓK—MEGYERI 1960) and the river water (GÁL 1963).

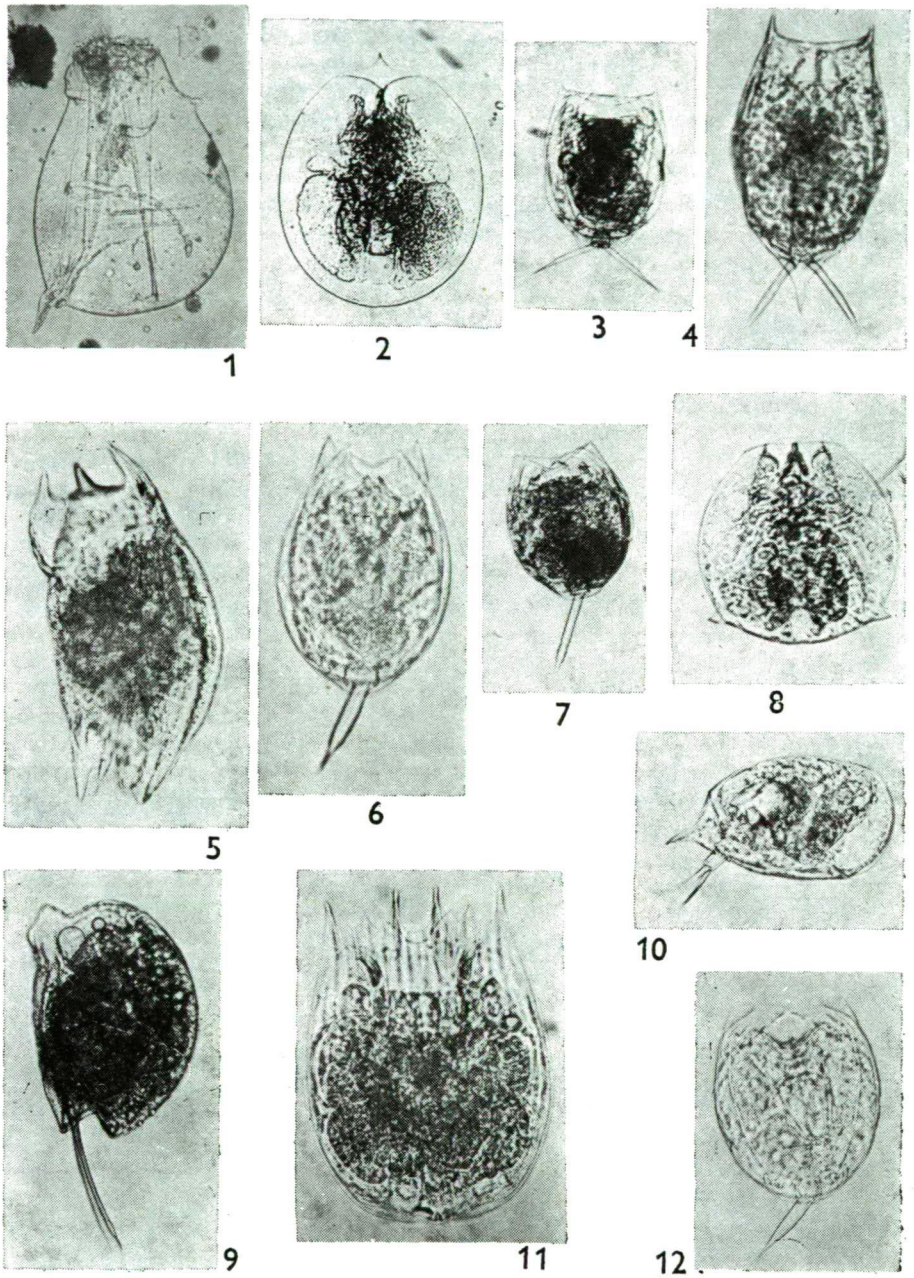
In 1969, it was found in the Füzes-ér in the course of the entire year, and in the stagnant water (except for one occasion August 19) on every occasion. In the borrowing pit, the presence of the species was only casual. In the Paptava three were observed three, in the Füzes-ér two multiplication maxima.

It is interesting that the periods of the multiplication maxima are given by the different authors at different dates. The presence in large numbers was given by B. CARLIN (1943) to take place from June to August, and he demonstrated more maxima, as well. On the other hand, B. PEJLER (1961) was mentioning there dates, falling to January, June, and November.

In the formation of the multiplication maxima of *Keratella quadrata* the temperature of water has — in addition to other factors — probably a considerable part. Comparing B. Pejler's data (1961) with those observed by us, a good conformity may be demonstrated. At the date of the maxima described by B. PEJLER (1961), the temperature values were 6 °C, 20 °C, 6 °C, and the values measured by us were formed in the order of succession: 7.5 °C, 20 °C, 5 °C. It is shown by the data that the multiplication maximum of the species — if other factors are also suitable — may take place independently of the season, in case of a suitable formation of the temperature conditions.

From among the varieties of *Keratella quadrata,* var. testugo was present in the standing water, in the Füzes-ér, and in the borrowing pits alike, var. cruvicornis, on the other hand, lived only in the Füzes-ér and the borrowing pits. In the Füzes-ér, the multiplication of var. *testudo* in large numbers was observed in November in the open water and the maximum individual density of var. curvicornis in March, at the sampling sites (1, 2, 3, 4) among the plants.

In the borrowing pits, the appearance of the species and its varieties was casual and unsystematical what may be connected with the estatic character of waters.



Pictures: 1 *Epiphanes clavulata* 2 *Testudinella mucronata* 3 *Lecane ungulata* 4 *Lecane ludwigi* 5 *Mytilina mucronata* 6 *Lecane hamata* 7 *Lecane lunaris* 8 *Testudinella parva* var. *bidentata* 9 *Mytilina mamillata* n.sp. 10 *Colurella adriatica* 11 *Notholca squamula* 12 *Lecane closterocerca.*

Lecane bulla (GOSSE)

It is frequently present in the plant-covered water-side zone of smaller or larger standing waters — namely dead-arms (MEGYERI 1961), saline waters (MEGYERI 1963), bog-waters (MEGYERI 1962, 1965) — and from time to time in their plankton, too, from Spring till Autumn (VARGA 1938, VARGA—DUDICH 1939, VOIGT 1956). It achieves its maximum individual number in Summer (VARGA 1939), but its occurrence in mass is rare. On June 30 and July 1, 1968, it was collected, in a comparatively small number at every sampling point of the profile (!).

At next sampling, on July 6—7, 1968, it was already found primarily in the waterside zone: A/1, B/1, B/2. The characteristic daily rhythm (!) of the motion of species was observed in the waterside zone of the standing water. At sampling sites A/1 and B/1, the fluctuation of individual numbers had the same tendency, while at point B/2 the tendency was contrary to the former ones (Fig. 1).

In the course of the samplings in 1969, it was found from June till September, primarily in the waterside regions, more rarely in the open water (C/1, C/2, C/3).

In the Füzes-ér, it was found at any sampling sites among plants. There were generally observed two maxima of its individual density in the summer months. The tendency of the multiplication of species has shown a considerable temporary displacement in the plant-associations of similar character, as well. The interpretation of this phenomenon can only be solved by further investigations.

Lecane closterocera (Picture 12)

It is a dweller of waters covered by water-plants richly. Being a eurytopic organism, it may be found in most various habitats. It was obtained from dead-arms (MEGYERI 1961), bog-waters (MEGYERI 1962, 1965, 1969), saline waters (MEGYERI 1963), from small waters in the mountains (ÁBRAHÁM—BICZÓK—MEGYERI 1960), and from psammon alike (VARGA 1938, 1957).

It was collected at all the sampling sites of the Füzes-ér. The species was present at the morassic SE corners (sampling sites 5, 6, 8) in larger numbers than at the other places.

At the other water-surfaces of the flood-plain, it was not found at any samplings.

Lecane curvicornis (MURRAY)

It is a wide-spread, sometimes frequent bog-water species VOIGT 1956). It is rare in the fauna of this country, collected so far but from three places — the small waters of the Bükk-mountains (ÁBRAHÁM—BICZÓK—MEGYERI 1960), a dead-arm of the Tisza: Dead-Tisza at Tiszazug (MEGYERI 1961), and the sphagnum-bogs at Nagybárkány (MEGYERI 1962).

In the course of our investigations, it was found on a single occasion in the waterside zone of the mortlake.

Lecane hamata (STOKES) (Picture 6)

It is a species living primarily among water-plants but appearing sporadically in the plankton, as well (VOIGT 1956).

In our fauna it is not too frequent. It was collected from the dead-arms (MEGYERI 1961), the bog-waters (MEGYERI 1962, 1965, 1969), and Lake Balaton (VARGA 1939, 1945, 1957).

It was found in the riverside region of the Bodrog-stagnant water, in a small individual number, in 1968 and 1969. In the Füzes-ér it generally occurs. In larger numbers it was collected in the summer months (20 ind./5 l — 280 ind./ 5 l), but a few individuals, at sampling site 8, were even found in a sample obtained from below ice. This occurrence is a very interesting datum because it is mentioned by several authors (*e.g.*, WULFERT cit. VOIGT 1956) as living in thermal waters.

It will probably prove to be an extremely eurythermous species.

Lecane ludwigi ROCHSTEIN (Picture 4)

It lives in the waterside zone of smaller and larger standing waters, among water-plants (VOIGT 1956). In our fauna it is not frequent — it was found in the bog-shrubbery of the Small-Balaton (VARGA 1945) and Lake Baláta (MEGYERI 1965).

In the Füzes-ér, except for sampling site 1, it was found everywhere (in months July, August, and September). It is not present in large numbers but, with its characteristic shape, it is a remarkable member of the metaphyton.

Lecane luna (O. F. MÜLLER)

It is to be found in the plant-grown watersize zone of lakes, smaller standing waters, casually in their plankton, as well (VOIGT 1956). In the summer months, it often appears in large numbers (VARGA—DUDICH 1939). On June 30 — July 1, 1968, there were collected but a few individuals of it. On July 6—7, their number increased to more than twentyfold what was doubtless connected with the environmental factors becoming more favourable. It was found in larger numbers in the plant-covered striple of the waterside, although it occurred casually among the plankton, as well.

The daily rhythm may be observed at this species, too, but not so unequivocally as in case of the former two (*L. bulla, L. galesta*).

In the Paptava, in 1969 it was present from June to September. Its multiplication maximum was observed here in July. In the Füzes-ér, in the summer months, it was found at any sampling sites. Although its individual density was not uniform, there could be observed no connection between the quantitative distribution of the species and the quality of vegetation. Its multiplication maximum fell here to July and August.

The species may be considered, on the basis of our investigations, as a summer element occurring primarily among plants.

Lecane lunaris (EHRB.)

It is a frequent species, living primarily among water-plants but occurring casually in the plankton, as well (VARGA 1931, VOIGT 1956).

In the fauna of our country it is very common. But it does not occur generally in large numbers. (VARGA 1928, 1930).

In 1968, it was found at any collections, mainly in the waterside zone, and a few individuals were also demonstrated from the open water.

In 1969, it was present in the mortlake from June to September but not in large individual numbers. Its multiplication maximum was observed in July.

It was demonstrated from any sampling sites, designated among plants. Its individual density — similarly to that observed in the Paptava — was in July the highest.

Lecane stenroosi (MEISSNER)

It is a wide-spread species of sporadic appearance (VOIGT 1956). In Hungary, it was found in Lake Balaton (VARGA 1939) and in some dead-arms of the Tisza (MEGYERI 1961).

In the summer months, it occurred in the mortlake and, except for sampling sites 6, 7, in the Füzes-ér, as well. We found it, in comparatively larger individual numbers, in June and July.

Lecane ungulata (GOSSE) (Picture 3)

In spite of being a wide-spread species (VOIGT 1956), in the waters of our country it is rather rare. It does not occur generally in large numbers.

In the late-summer, early-autumnal months, it was found in the Füzes-ér, at any sampling sites, as a rule, in a small individual number (1 to 30 piece/5 l).

Lecane quadridentata (EHRB.)

It is a wide-spread species but often with a local appearance. It is thermophilous, preferring the warmer waters (VOIGT 1956). In our waters it is rare, being collected even in its habitats but in small individual numbers (VARGA—DUDICH 1939).

In the course of our samplings in 1968 it was found on both occasions. In windy weather, under unfavourable conditions, there could be collected not more than eight individuals, while on the next occasion — in a good weather — approximately 500 individuals were found.

In 1969, from June to September, they were collected mainly from the waterside zone of the mortlake and casually from the plankton, as well.

In the Füzes-ér, in the summer months, it generally occurred. Between the individual density of the species and the quality of macrovegetation no essential connection could be demonstrated. In larger individual numbers it was present in the summer months.

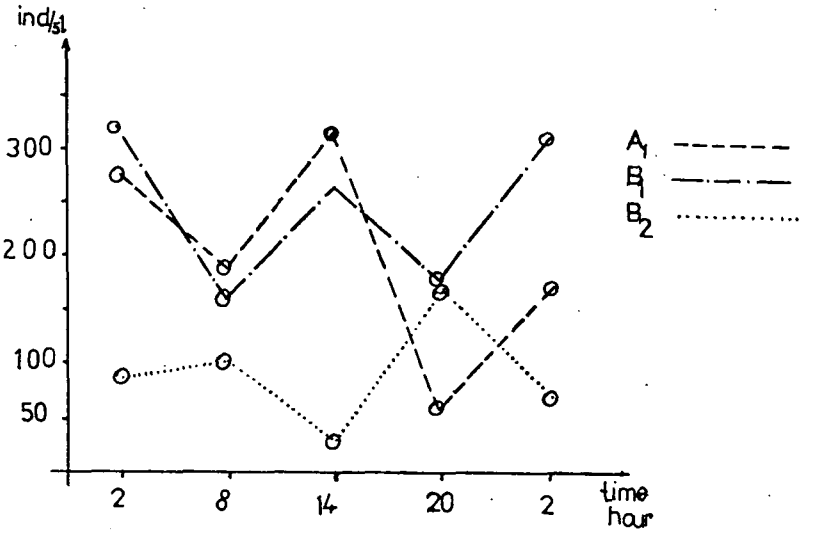


Fig. 1. Migration of *Lecana bulla* in the parts of the day, in the dead-arm of the Bodrog.

Lepadella acuminata (EHRB.)

It is to be found in sources, brooks, peat-boas, in the plant-grown waterside zone of standing waters (VOIGT 1956).

In our fauna it is no frequent element. It can be found within comparatively wide temperature limits, as well. Thus, it was collected by J. DADAY (1891) in the 32 °C water of the bath Püspökfürdő, by J. MEGYERI (1962) in bog-water at a site of 12.5 °C water-temperature. It is held by L. VARGA (1939) to be a eurytopic species!

We have only collected it in the Füzes-ér. It was found but in a small individual number but was a constant enough member of the plant-grown waterside zone.

A few individuals were found in the winter samples, as well. These had lived here at about 3 °C water-temperature.

Lepadella patella (O. F. MÜLLER)

It is a eurytopic organism, living in the vegetation of some small and large standing waters (VOIGT 1956). It is still mentioned by L. VARGA E. DUDICH (1939) as a rare species in the fauna of this country. Of late years, however, it was found in so many places — in small waters of the mountains (ÁBRAHÁM—BICZÓK—MEGYERI 1960), dead-arms (MEGYERI 1961), bog-waters (MEGYERI 1965, 1969), Lake Balaton (VARGA 1945, 1957) — that it is rather to be considered as a frequent species. On June 30 — July 1, 1968, we collected from any sites of the sampling section of the mortlake. On July 6—7, — when the weather conditions became normal — not a single individual of it was found any more. The unfavourable weather conditions observed on June 30 — July 1 and before that date, too, may have conduced to the transitory disappearance of the species; on August 31, 1968, it was namely again found in a considerable number.

In the Füzes-ér, it was present at any sampling sites but, apart from a few exceptions, not in large individual numbers. By reason of our data, the multiplication maximum of the species took place in June and July.

In the mortlake, on July 21, 1969, a species variety of it, *Lepadella patella* var. *similis* was found, in an almost identical quantity with the basic species. Var. *similis* is in our fauna rather rare (VARGA 1949, MEGYERI 1963).

Lepadella ovalis (O. F. MÜLLER)

It lives mainly in the vegetable detrius, rarer in the plankton (VARGA 1931, VOIGT 1956).

In our country it occurs systematically in very common smaller and larger standing waters (DADAY 1891, ÁBRAHÁM—BICZÓK—MEGYERI 1960, MEGYERI 1961, 1962). It achieves the peak concentration on of its amount in Summer (VARGA—DUDICH 1939).

In the course of our samplings, on August 19 and September 25, 1969, it was found in the mortlake, on both occasions in the zone of the waterside fringe.

In the Füzes-ér, except for sampling site 3, it occurred in any plant-covered places.

Its multiplication on maximum was not express, but in the summer months it was found in larger numbers than in winter.

Lindia torulosa DUJARDIN

It is a wide-spread species, to be found in the water-vegetation and at the surface of bottom-mud (VOIGT 1956). In our country it is rare. In the fauna, in the vicinity of

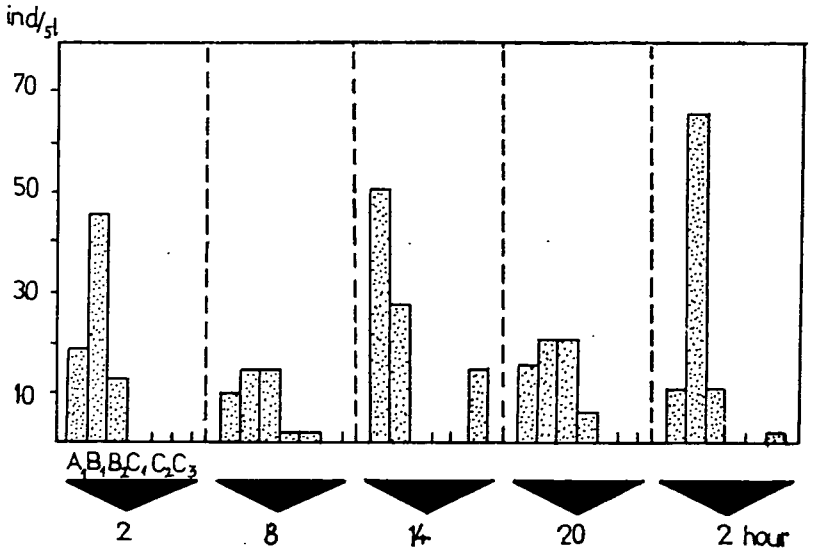


Fig. 2. Quantitative distribution of *Lecane luna* in the riverside zone the dead-arm of the Bodrog.

Budapest, it is made known by K. KERTÉSZ (1894), using the data of S. TÓTH (1861) and T. MARGÓ (1879), as well.

In August and September, it was found at sampling sites 3, 4, 5, and 8. The late-summer — early-autumnal occurrence of the species may have been influenced favourably by the considerable accumulation of the organic tripton.

Mytilina mucronata (O. F. MÜLLER) (Picture 5)

It can be found among the detritus of water-plants (VOIGT 1956), in the bottom deposit (FEJLER 1962).

In our country it is a species of frequent appearance (DADAY 1891, MEGYERI 1960, 1963, VARGA 1939, 1945) but without occurring in large numbers (Varga—DUDICH 1939). By reason of the occurrence data, it may be regarded as a column species of wide ecological valence.

In the mortlake, it was collected on June 23, 1969, at sampling site B/2. In the Füzes-ér, it was found at sampling sites 6, 7, and 8, on any occasion in a small individiual number.

Mytilina mamillata n.sp. (Picture 9)

In the course of our samplings, this animal of strange shape that cannot be identified with any of the Mytilina species described so far, was found at the sites of the Füzes-ér, grown by water-vegetation richly (sampling sites 5, 7, and 8). It is most similar to *M. acanthophora,* described by J. HAUER from the Island of Java in 1931 but it is also showing some differences from that in respect of several considerable characteristics.

The surface of the carapace is made uneven by small protrusions (Fig. 3). In the anterior edge, shifted towards the ventral side, an eminence ending in a small protrusion is to be found. The side-feelers in the lower one-third of the carapace do not sit on an eminence. The leg is not covered by a semicircular lobe! The fingers are pointed. The eyespot is hardly perceptible. The length of the carapace is 164 μ, its breadth is 120 μ, the length of the toe is 88 μ.

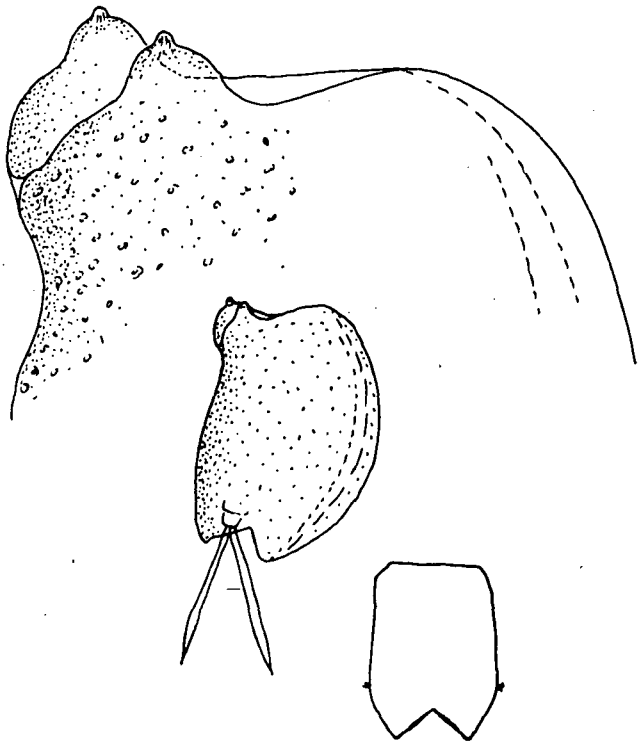


Fig. 3. *Mytilina mamillata* n.sp.

Notholca squamula (O. F. MÜLLER) (Picture 11)

It is a cold, stenothermous species (VARGA 1932), frequent in the plankton of lakes (VOIGT 1956). According to B. CARLIN (1943), its multiplication maximum falls to the early spring months. In the fauna of this country it probably occurs much more frequently than shown by the literary data. It was so far described but from a few sites — from the Balaton (VARGA 1932, 1939, 1941, 1957), from the small waters of the Bükk-Mountain (MEGYERI 1960), and from the Fürj-ér (DÉVAI 1970).

In the mortlake and the Füzes-ér, too, it was only found on April 26, 1969, at 8° C water-temperature. Its individual density at the single sampling sites was considerably different from one another.

It is shown by our data that Notholca squamula, apart from the cold waters, occurs in the places rich in decomposing organic matters, in larger individual numbers.

Pedalia mira (HUDSON)

It is a species being present in the plankton of the smaller and larger standing waters (VOIGT 1956).

It is a very frequent member of our fauna from June to October (VARGA 1931). It is considered by J. MEGYERI (1939) as the character-species of saline waters, although it was found, on more occasions in the dead-arms of the Tisza (MEGYERI 1961) and the bog-water (MEGYERI 1965), as well.

We found it in the course of the samplings in 1969, in the qualitative sample scooped out of the mortlake — what means the filtrate of about 50 l water — on July 21, as a single individual with eggs. On September 25, it was already found in the quantitative samples, as well, from the sampling points designated at the border of the open water and hair-weed. (B/1, B/2, B/3).

In the Füzes-ér, an individual was only found at site 3 (along the canal joining the dead-arm with the Füzes-ér).

Platyias quadricornis (EHRB.)

It is to be found in smaller standing waters, richly covered with plants (VOIGT 1956), in periodical pools of flood-plains (SPANDL 1926).

In our fauna, it is very frequent in dead-arms (MEGYERI 1961), bog-waters (MEGYERI 1965, 1969) — a typical summer species (VARGA 1939).

It occurred in any water-area investigated in the flood-plain, from June to September. But in large numbers it was found on no occasion.

Platyias patulus (O. F. MÜLLER)

It is wide-spread but often with a sporadic appearance (VOIGT 1956). It lives in smaller or larger standing waters, rain-water pools (SPANDL 1926), as a rule, among water-plants. In our waters it is a frequent species (KERTÉSZ 1894 MARGÓ 1879, DADAY 1892, 1883, 1885, VARGA 1953, MEGYERI 1961, 1965, 1969).

In the course of our samplings, it was found in the Paptava and the Füzes-ér, from June to September. Its multiplication maximum was observed in July and August, with 300 to 500 piece/5 l individual density.

It generally occurs together with *Patyias quadricornis* what is to be explained probably with the similar ecological demands of both species.

Polyarthra platyptera (EHRB.)

It is a polycyclic (DEIFFENBACH—SACHE 1911), eurytopic species (AURICH 1933), to be found in smaller or larger standing waters (DADAY 1885, 1896). The temperature-limits of its occurrence are given by I. FINDEREGG (1953) between 1.2 °C and 2 °C.

It was found on a single occasion, on July 21, 1969, at sampling site 1 in the Füzes-ér, in a water of 20 °C temperature.

Polyarthra remata SKORIKOV

It is wide-spread in small waters and lakes (VOIGT 1956). According to B. CARLIN (1943), its multiplication in large numbers is to be expected between 5 °C and 20 °C.

In the mortlake and the Füzes-ér, it was collected in larger individual numbers in Spring and Autumn, although a few individuals were present in the summer months, as well.

Popmholyx complanata (GOSSE)

It is a rare species (VARGA 1932) in the plankton of smaller and larger standing waters (WOYSAROVICH 1938) but appearing casually in large numbers, as well (VOIGT 1956).

It was found on a single occasion, in a small number, at sampling site 1.

Scaridium longisudum (O. F. MÜLLER)

It can be collected from among plants, out of smaller or larger standing water, from May to October (VOIGT 1956). According to B. PEJLER (1962), it can be found in the bottom deposit, as well.

In our fauna it is not frequent.

In 1969, it was collected systematically in the mortlake and the Füzes-ér, from July to September. But at sampling site 7, a few individuals were even found in November. It was present in the shallower places (A/1, 1) in larger individual numbers.

Stephanoceros fimbristus (GOLDFUSS)

Dwelling on plants, it lives in cold waters (VOIGT 1956). From the territory of our country, it was described first by K. KERTÉSZ (1894) in the fauna of the environment of Budapest, under the name of *Stephanocoeros sichorni* EHRB. 1832. An individual of it was found on March 4, 1970 (!), at sampling site 8, in a sample dipped out from below the ice.

Synchaeta oblonga EHRB.

In this country, it was only found in a few places — the Balaton (VARGA 1932, 1937, 1939), the vicinity of Orosháza (MEGYERI 1965), and the Fürj-ér (DÉVAI 1970. It is held to be a cold stenothermic animal (VOIGT 1956). In the mortlake, on April 26 and November 10, it was collected in a small number. In the Füzes-ér, however, except for sampling site 2, it was found in large numbers.

Synchaeta pectinata EHRB.

Similarly to *Synchaeta oblonga,* it is a cold-water species (VARGA 1932). In our country it is known but from a few places.

It is regarded by H. J. AURICH (1933) as eurytopic. The temperature limits of its occurrence are given between 2.5 °C and 13 °C — what keeps within narrow enough bounds the presence of species.

In the mortlake and the Füzes-ér it was found on April 26 in considerable individual numbers. In the Füzes-ér it was again present in September and November. Its individual density, however, except for site 6, did not achieve the spring level.

On a single occasion, on July 22, it was found in large numbers in borrowing pit R/1, as well, where the temperature of water was 20 °C.

Taphrocampa anguloca GOSSE

It lives in smaller lakes, pools, among water-vegetation (VOIGT 1956). It is a rare species (GUTTMANN 1962). In our fauna it is of sporadic appearance. It was found in the Balaton (VARGA 1939, 1941, 1945) and in the Fürj-ér (DÉVAI 1970).

On August 19, 1969, in the Füzes-ér, a few individuals of it were only found at sampling site 7.

Testudinella mucronata (EHRG.) (Picture 2)

It was found on a single occasion in a sample, dipped out of the mortlake of the Bodrog, from below the ice.

In the fauna of this country it is rare!

Testudinella parva (TERNETZ)

It is a wide-spread species, occurring sporadically in smaller and larger standing waters, among water-plants, and in bog-waters (VOIGT 1956).

In the mortlake and the Füzes-ér it occurred generally. The maximum of its individual density was observed in June. After that time, we collected it in more and more decreasing numbers, and in November we could find it no more.

In the Füzes-ér, we found a species-variety of it: var. bidentatus (TERNETZ 1892) (Picture 8), found in our fauna first by L. Varga (1932), in the water of the "Nagytó-malom" lake at Sopron. It was present in the summer months.

Trichocerca bicristata (GOSSE)

It is a species living in the midst of water-vegetation but often occurring in the plankton, as well (VOIGT 1956).

In our fauna, it was collected so far from Lake Small-Balaton by L. VARGA (1945), and from the Dead-Tisza at Tiszazug by J. MEGYERI (1961). In the Füzes-ér, except for sites 1 and 6, it was found casually among the plants, in changing individual numbers, in the late-summer and autumnal months.

Trichocerca birostris (MINKIWICZ)

It is no frequent species. It is a member of the plankton of lakes and smaller standing waters (VOIGT 1956). In our fauna it is rare.

In 1969, in the course of our samplings in the mortlake, it was found in the plankton of the borderland between the open water and weed-hair from July to November.

Its multiplication maximum, correspondingly to the literary data (PEJLER 1961, NAUWERCK 1963) fell to September. In the Füzes-ér, it occurred both in the plankton and in the metaphyton (!). The maximum of its individual density, as distinct from the mortlake, could be observed in July and August. This may supposedly be brought into connection with the early formation of a large amount of organic detritus.

Trichocerca capucina (WIERZEJSKI u. ZACHARIAS)

It is wide-spread and to be found in the plankton of smaller and larger fresh waters (VOIGT 1956) and among the water-vegetation (VARGA 1932, 1945). In our fauna, it is rare, and was so far found only in the Balaton (Varga 1932, 1945).

In 1969, it was collected in the plankton and the waterside zone of the mortlake. It was only present in the autumnal months (August, September) in not large individual numbers.

Trichocerca longiseta (SCHRANK)

It is to be found in the midst of the vegetation of shallow waters (VOIGT 1956), in the plankton (VARGA 1931), in algal covers (PEJLER 1962).

In the waters of this country it is not frequent.

On June 30 — July 1, and July 6—7, 1968, it was collected in the same number, on the first occasion mainly from the plankton, for the second time from the border of the plant-grown zone (B/1, B/2).

In 1969, from June to September, it was mainly found in the borderzone of the open water and the hair-weed. It probably prefers the waters grown in rarely by plants. The multiplication maximum of the species was observed in July.

It was collected from any sampling sites of the Füzes-ér, being systematically found at sites 1, 2, and 3. At the other sampling points it occurred only casually. Its multiplication maximum took place here in June. It is interesting to observe how *Trichocerca longiseta* and *Trichocerca birostris* altercate with each other in the mort-lake (cf. Fig. 4). In the Füzes-ér, the situation is similar, but with the difference that the maxima of the individual density of the species mentioned develop a month earlier. It is probable that the ecology of both species is considerably identical, their phenomenological rhythm is however different.

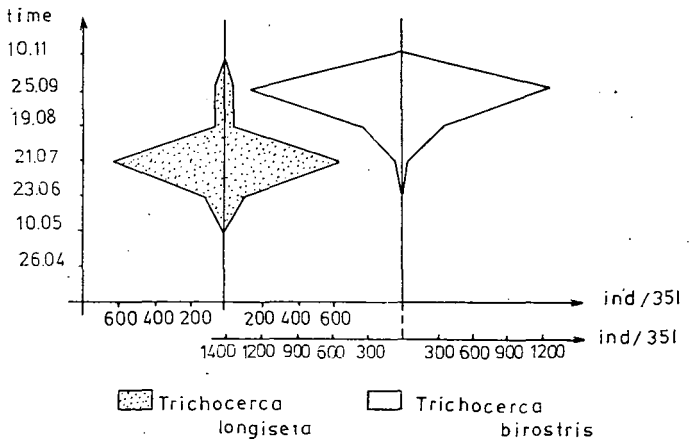


Fig. 4. Quantitative relation of *Trichocerca longiseta* and *Tr. bicristata* in the dead-arm of the Bodrog.

Trichocerca tigris (O. F. MÜLLER)

It is a wide-spread species, living among the vegetation of larger standing waters, smaller lakes, pools (VOIGT 1956, VARGA 1945). In our fauna it is very frequent. It was collected in the summer and autumnal months in the Füzes-ér, in a comparatively small individual number. In spite of its small individual density, it was a characteristic member of the metaphyton.

Distribution of the Rotatoria fauna in space and time and the factors influencing it

Spatial conditions of occurrence

We have tried to clear up — in first approximation — the spatial distribution of Rotatoria in the course of studying the Rotatoria fauna of the shelter forest at Sárospatak and the flood-plain of the Bodrog. At our investigations, we have followed

with attention what kind of effect is exerted and what changes are induced by the environmental factors in the composition of the species associations.

From among the water surfaces of the flood-plain, we have investigated in the mortlake of the Bodrog the Rotatoria stands of the water-area details, differing even habitually from one another — namely that close to the waterside A/1, the transitional zone between reed-grass and open water B/1, B/2, B/3, and the open water C/1, C/2, C/3.

Such a distribution of the water surface is primarily justified in the summer period when a rich macrovegetation is growing in the mortlake. In Spring and Autumn, there is no considerable difference between the species and individual number compositions of the zones. In the spring period, the characteristic plankton-dwelling Rotatoria — like *Keratella cochlearis, Keratella quadrata, Filinia longiseta* — occur in the whole section.

In the waterside samples A/1, the species preferring the shallow waters warming up fast, that are less sensitive to the fluctuation of temperature and having generally a rich vegetation, namely *Brachionus rubens, Buchlanis ovata, Mytilina ventralis, Lepadella patella, Colurella adriatica, Scaridium longicaudum,* are dominating.

At the border of the reed-grass zone, B/1, B/2, B/3, where the "saligot-carpet" begins to grow already much thinner, the majority of the Rotatoria species occurring in the section can be collected. This zone is most variable: the species composition of the fauna and the change in the individual numbers of the single species considerably depends upon the formation of the external environmental factors. Is, for instance, the open water touched by any disturbing effect, *e.g.* stirred up by a strong wind, then a considerable part of the plankton organisms gets even into the more protected zone of the "saligot-carpet". It may occur, on the other hand, as well, that the animals, living otherwise among the plants, are casually drifted out, or get out of this zone by their own motion.

In this transitional zone can, therefore, both the species living in the metaphyton and those living in the plankton, be found, but the composition of the number of species and individuals is very changing.

In the open-water zone C/1, C/2, C/3, the real planktonical species *(Keratella cochlearis, Keratella quadrata, Filinia longiseta, Asplancha priodonta, Polyarthra remata)* are dominant. The dynamism of the change in the composition of species and individual numbers — apart from the drastic, unseasonable conditions met with from time to time — has developed seasonably.

In open water, besides the possibility of the planctonic way of life, a good food-supply is also provided for. As a food partly a large mass of the organic detritus washed in from the waterside zone, partly the algae living there are to be taken into consideration.

We are trying here to outline the similarities and differences, observed between the Rotatoria communities of the water-areas with different macrovegetations, by reason of analysing the faunas found in the various plant stands of the Füzes-ér.

On the basis of our preliminary investigations and literary studies, we have started from the supposition that in the different plant stands there are different Rotatoria communities to be found. It is, however, shown by the results of our annual fact-finding series that the conclusion drawn on the basis of our preliminary investigations and literary studies was not quite exact.

In the Summer of 1967 and 1968, the samplings were carried out casually. We observed, therefore, some qualitative and quantitative differences between the Rotatoria

stands at the different sampling sites. But investigating our systematic data from 1969 contracted, these differences became blurred completely.

The Rotatoria living in the midst of vegetation were treated of, even on a world scale, but by few authors (HAUER 1952, MÜLLER-LIEBEHAU 1956, MÜLLER 1961, KOCH-ALTHAUS 1963, STRASKRABA 1965).

In domestic relation several investigations of this character were performed (ENTZ 1947, VARGA 1931, 1941, MEGYERI 1961, 1962, 1965, NÓGRÁDI 1962) but without any concrete referring to what kind of Rotatoria communities can be found in the plant-stands given. The composition of the macrovegetation was generally only given in a list of species, although in some cases (VARGA 1941, MEGYERI 1965) the plant species were also given where the Rotatoria were collected from. And the data of all the sampling sites marked out in the water-area were frequently dealt with, contracted in a uniform list of species.

In spite of that the investigations were performed by the authors mentioned in geographically different places, in various watertypes and in waters having casually similar but often also different plant stands: the dominant genera agreed in any case with one another, and at species level, a high degree of similarity manifested itself. The differences, observed in the species composition of the Rotatoria-stands in the single areas, could equally be derived from the different geographical situation of the sites of investigation or from the differences in the water-type as from the differences of the macrovegetation.

Our investigations were carried out in identical water-types and geographical places but on different plant-stands. We could therefore observe unequivocally the effect of macrovegetation on the Rotatoria fauna.

Investigating the data of the systematical investigation-series in 1969, as contracted according to sampling sites, we could not observe any essential and consistent difference in the single plant associations, in the composition of the species and individual numbers of Rotatoria — taking into consideration mainly the dominant species.

Independently of water-depth and the quality of vegetation (reed-grass; submerged natant plant; uliginal vegetation), the fauna of the Füzes-ér proved to be homogeneous enough. On the basis of the results of investigations, it does not seem justified to establish some characteristic species communities in case of Rotatoria that would only occur in the given plant associations.

To be sure, Rotatoria do not follow the plant associations because these ensure primarily but a substratum for their species and, owing to their small stature, the quality of vegetation (species-combination, leaf-proportions, gnarled or smooth surface of the stalk, etc.) is not determinant for them. Those of the species, living among plants, which can remain in the plankton by swimming for a long enough time *(Testitudinella patina, Lecane quadridentata)*, could systematically be found in the plankton samples, as well. Our former statement, namely that for the Rotatoria living in the waterside zone the reed-grass and uliginal vegetation do primarily count but as a substratum, is proved by this circumstance, as well. There may be considered as a similarly important proof, too, that the typical metaphyton species (*Lecane, Trichocerca* species) appear together with the vegetation (in May), their multiplication follows, however, only late in Summer when the food-requirements of the species appearing in a higher individual density are already satisfied by the amount of the organic detritus coming from the vegetation decayed, but there are still enough plants serving for a substratum, too.

It is to be supposed by reason of the data of investigation that it is similarly not

of crucial importance for Rotatoria, at what kind of plant species the detritus or organic tripton, serving for their food, came about.

At the different plant-stands, as seen above, we have found some Rotatoria communities that were very similar to one another. In the layers of different depth of the water-area, on the other hand — in spite of the shallow water of the flood-plain — the vertical articulation of Rotatoria could be observed. This is demonstrated in any sampling section of the Bodrog mortlake, on the basis of our experiences. The bed of the mortlake was divided with sampling points into a surface A/1, B/1, C/1 zone, a 1 m deep B/2, C/2 zone, and a B/3, C/3 zone, near to the bottom.

In the surface region of the open-water area, apart from the enormous multiplication of one of the species from time to time (*e.g.*, that of Keratella cochlearis), the species and individual numbers of Rotatoria are generally small. At sampling sites A/1 and B/1, in the course of Summer, owing to the overshadowing effect of the saligot-carpet covering the water surface almost continuously, there were sometimes to be found some species, as well — mainly from the neighbourhood of sampling point B/1 — which do otherwise occur in larger numbers in the deeper layers of the open water *(Platyias patulus, Testudinella trilobata, Lecane luna)*. The middle zone of the water-area, in 1 to 1.5 m depth (B/2, C/2) is the richest one in Rotatoria. In this place, namely, besides the species characretistic of this depth-level *(Keratella cochlearis, Polyarthra remata, Polyarthra longiromis, Asplanchna priodontna)* the species preferring the water-layer close to the bottom *(Plantyas patulus, Platyias quadricornis, Brachionus quadridentatus, Lecane lunaris)* may also be found. It seems so that in this zone most species do find the living conditions they need for surviving and multiplying.

The organisms living in the deeper water-layers, B/3, C/3, are least affected by the momentary changes of the external environment. Accordingly, here generally stay the species which are supposedly more sensitive to a quick change in the ecological factors, for instance temperature, the intensity of mingling and consume primarily detritus as food. *Platyias patulus, Platyias quadricornis,* etc. are to be found here almost constantly.

The spatial distribution of Rotatoria is also under the influence of environmental factors as, for instance, apart from being stirred up by the wind, of the migration of species according to the parts of the day.

The investigation and elucidation of the spatial distribution of Rotatoria and generally of plankton-organisms are, as seen above, nearly indispensable for the exact causal cognition of the biological processes taking place in the aquatic ecosystems.

The knowledge of the spatial distribution of the Rotatoria fauna is also at the planning of samplings a very important point of view to be taken into consideration. At food-biological investigations, it also furnishes practicable data of good informative character for exploring the conditions of occurrence of the consumer organisms to be expected in the given water-area.

The composition of the species and individual number of the Rotatoria fauna is highly changing. Corresponding to their changes according to the parts of the day and seasons, there are to be distinguished daily and annual rhythms.

The problem of the migration of plankton-organisms according to the parts of the day is generally treated of within the domain of the vertical distribution of species. This standpoint is justified by the notion of migration according to the parts of days, allowing a conclusion concerning the migration of species from their individual density observed at the different sampling points at various points of time.

According to BAYLOR-SMITH, 1957, the vertical migratis is fundamentally a real complex composition of geotaxis and phototaxis, as influenced by the number of the

environmental parameters. Under the parameters of the environment are the light-conditions, temperature, air pressure, pH, oxidation-reduction potential, etc. to be understood. The latter formulation is referring to the causes of the migration of plankton-organisms, as well.

In my opinion, it is justified by the latter formulation to deal with the problem of the migration of plankton-organisms in the domain of the changes in time because the spatial arrangement of species is influenced by the changing environmental factors (in compliance with the changes in the parts of the day).

There are but few data to be found, even on a world scale, concerning the problem of the migration of Rotatoria according to the parts of the day [BARTHELIMESS 1960, HAUWERCK 1963, HUBICEK 1964, GEORGE-FERNANDO 1969). But even these data are, unfortunately, not comparative ones, because partly the time passed between the sampling points of time is different, partly the environmental data published are not detailed enough.

The migration of *Lecane bulla, Lecane luna,* and *Mytilina ventralis* according to the parts of the day in the waterside zone of the mortlake was observed in the course of our 24-hr recordings carried out on July 6—7, 1968 (we were sampling in every 24 hours). There have, supposedly, several Rotatoria species a daily rhythm of the same, or similar, character but it has not become known, as yet, due to the low number of the 24-hour investigations.

The migration of Rotatoria according to the part of the day is known, for the time being, but a little. In spite of this, the existence of this phenomenon is anyway to be taken into consideration at planning the samplings.

At the annual survey of the Rotatoria fauna in the flood-plain of the Bodrog we have obtained an unequivocal connection between the species and individual number composition of the Rotatoria communities from the samples drawn from the water in different seasons, as well as between the development and perishment of the macrovegetation.

On the occasion of the spring floods, the beds of the water-areas in the flood-plain became completely washed through (!), and the large amount of the organic detritus accumulated there in the previous year or season was washed out. After the withdrawal of flood, a broad open water-surface was left over in the bed. After the deposition of the organic and inorganic detritus materials stirred up by the flood-wave, there were produced favourable essential conditions for the multiplication of the planctonical Rotatoria in all the water-areas.

There cannot be demonstrated any essential differences between the species compositions of the Rotatoria fauna in the waterside and open-water samples, originating from this period (May 26) and drawn from the same depth. Apart from the species preferring colder waters (8 °C) *(Motholca squamula, Synchaeta oblonga, Synchaeta pectinata),* real plankton-organisms *(Keratella cochlearis, Keratella quadrata, Asplanchna priodonta, Polyarthra longiromis, Epiphanes senta)* were dominant both in the mortlake and the Füzes-ér.

The full-development of the aquatic macrovegetation takes place in late May — early June. The above-detailed species-communities of the water-areas, separable well even physiognomically, (waterside, reed-grass, open water), are obtained from the samples of June, July, and August. In June, simultaneously with the development of the rich vegetation, do appear the species of genus *Lecane (L. bulla, L. luna, L. lunaris),* genus *Trichocerca (Tr. longiseta, Tr. alangata, Tr. agnatha),* as well as the species of genera *Testudinella, Colurella, Lepadeka,* and *Mytilina.*

To the multiplication of the species of the genera mentioned may have contribu-

ted favourably the rise in temperature, as well. The occurrence of their majority is nevertheless connected primarily to the presence of the macrovegetation. If these perish, simultaneously they disappear, as well, even from a biotope of an otherwise still favourable water-temperature.

The decay of vegetation began to be vigorous in late September and ended till the end of October. The species characteristic of this period, like *e.g. Lepadella ovalis, Lecane hamata, Trichcerca birostris, Trichocerca capucina, Testudinella trilobata,* prefer the waters that are rich in breaking up organic substances. The fact that their presence is determined primarily by the rich organic detritus content of the water and not, *e.g.* by temperature, is proved suggestively by the occurrence data of *Trichocerca birostris* (Fig. 4) and *Trichocerca capucina.* These could not be observed in Spring; in Autumn, however, they multiplied in large numbers. Parallel to the change in the environment, casually to the development and the decay of vegetation, the formation of the multiplication maximum of *Trichocerca longiseta* and *Trichocerca birostris* in the mortlake (Fig. 4) was striking. It is probable that not only the phenologic rhythm but, to a certain extent, also the ecology of the two species are dfferent. The multiplication maximum of *Tr. longiseta* fell to July, the main growing season of the macrovegetation, that of *Tr. birostris* fell, however, to September, the period of the decay of vegetation.

The multiplication of Rotatoria, as touched already before, is also influenced by the formation of water-temperature. The primary cause of the appearance, multiplying and disappearance of Rotatoria is seen by several authors (GARLIN 1943, NIPKOW 1961, PEJLER 1961, 1962, NAUWERCK 1963) in the favourable formation of water-temperature.

Comparing the results of my investigations with the data of GARIN (1943) and PEJLER (1961), apart from the general similarities, in case of *Asplanchna pridonta* and *Keratella quadrata* I came to the conclusion that the multiplication maximum of the species is not necessarily connected to a given season but, supposing the optimum existence of other factors (macrovegetation), too, primarily to the favourable formation of water-temperature.

At the macrovegetation-covered sampling sites of the Füzes-ér, between April 26 and September 25, 1969, the relation of the species and individual numbers of Rotatoria developed in any case in a contrary direction — corresponding to the literary data: there belonged a large individual number to the small species number, and a small individual number to the large species number (Figs. 5, 6).

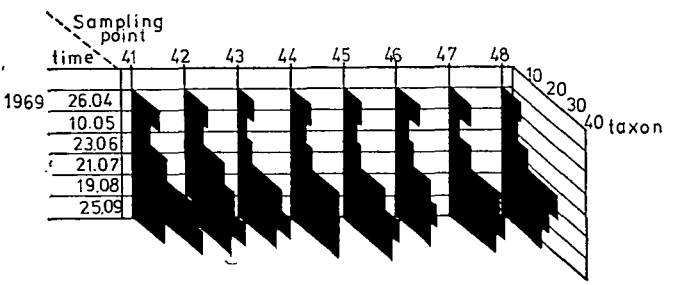


Fig. 5. Formation of the species number of Rotatoria in the dead-arm of the Bodrog, in 1969.

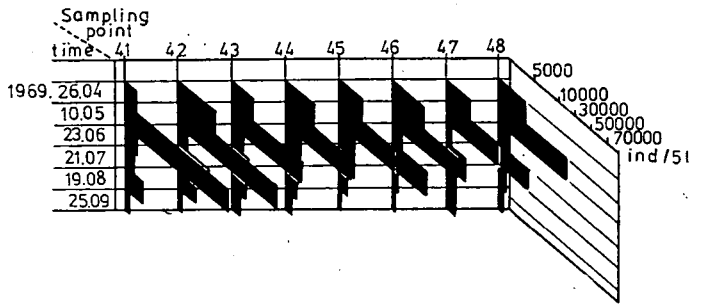


Fig. 6. Formation of the individual density of Rotatoria in the dead-arm of the Bodrog, in 1969.

*

Taking into consideration the descriptions above, the Rotatoria fauna of the mortl ake, the Füzes-ér, and the borrowing puts may be characterized as follows:

Of the Rotatoria fauna of the mortlake and Füzes-ér the species preferring standing waters are characteristic. In the borrowing pits, there are rather dominant the species of a short life-cycle, tolerating the changes in the environmental factors well, with an inclination to dry up.

Owing to the considerable expansion of the macrovegetation, the number of the real plankton-organisms in the mortlake were more or less agreeing with, — in the Füzes-ér always considerably lower than — that of the metaphyton species.

Our observations concerning the character species of the eutrophic waters have resulted in a similar statement. In the mortlake there were found several such species, but their individual numbers manifested themselves to be considerably lower than in the Füzes-ér.

From the mortlake there were demonstrated 69, from the Füzes-ér 117 Rotatoria taxons. The difference manifested in the species number and the qualitative composition of the Rotatoria fauna in both water-areas can be explained, in some degree, with the difference in the macrovegetation of the two water-areas, with the peculiar form of the bed-structure, and the degree of difference in eutrophization. While namely in the mortlake the nearly homogeneous stands of Trapa natans are to be found, the vegetation of the Füzes-ér is characterized by variety. The Rotatoria fauna of the mortlake and the Füzes-ér — supposedly because of the identical origin of, and the constant connection between, their waters — is showing, apart from differences, a considerable similarity, taking also into consideration the individual number of the 53 species which are present in both water-areas.

The Rotatoria fauna of the borrowing pits is decisively determined by the complete lack of macrovegetation, by their being overshadowed, and by a large mass of the allochthonous organic matter that had got into their water. The 15 species demonstrated from the borrowing pits, with the exception of one species, occurred in the Füzes-ér, as well, and eight of them were also present in the mortlake. The large number of the common species in the water-areas of the flood-plain, in addition to the common origin of waters, are referring to a food-supply being quantitatively similar in these waters.

In the spring and autumn months — before and after the main growing period of the macrovegetation — when the whole watet-area may be considered as having

the character of a uniform open water, the planctonic species (*Asplanchna priodonta, Filinia longiseta, Keratella cochlearis, Keratella quadrata, Synchaeta oblonga,* etc.) were dominant. Simultaneously with the expansion of macrovegetation, the plankton-dwelling species were driven into the background and, both in respect of the species and of the individual numbers, the metaphyton-organisms (*Lecane bulla, Lecane hamata, Lecane ungulata, Colurella uncinata, Testudinella bicristata,* etc.) have come into prominence.

In the physiognomically different parts of the water-area, during the period of investigations, the individual density of Rotatoria was formed variously. In the period of the spring multiplication maximum their number were considerably larger in the places where in the summer months a rich macrovegetation was growing. On the other hand, on the occasion of the late summer maximum, in the deeper parts of the bed, we observed a higher individual density in open-water. This phenomenon can be brought, in our case, into connection with the food-supply that was different in the various parts of the water-area.

The Rotatoria communities living in different vegetation water-organisms have shown in the Füzes-ér, considerable similarity in respect of species and individual numbers. It seems that for Rotatoria the macrovegetation is primarily important as a substratum serving for settling place. And as Rotatoria are organisms of very small size (50 μ—150 μ), in their case the quality of plant surfaces is not determinant. They are not particular about the origin of the organic detritus, either, serving as food for them. It may have been caused by these two facts in our case that in the different plant-stands very similar Rotatoria communities were found.

The lesson to be drawn from our fact-finding investigations is that the temporal (seasonal) appearance and multiplication of Rotatoria of large numbers must have been considerably determined — in addition to the endogenous factors — from among the environmental complex investigated: by water-temperature, the favourable food-conditions, as well as by the presence, resp. absence of the substratum.

In the course of our 24-hour investigations, the migration according to the parts of the day of four species *(Lecane bulla, Lecane galeata, Lecane luna,* and *Mytilina ventralis)* was observed.

It can be established by reason of our data that the plankton-members to be found during the whole year, namely the species *Keratella cochlearis, Keratella quadrata, Asplanchna priodonta,* and *Polyarthra,* are characteristic of the Rotatoria fauna of the Bodrog-dead-arm and the Füzes-ér. And in the waterside zone, the species connected to the presence of the macrovegetation: *Philodina megalotrocha, Lecane bulla, Colurella adriatica, Lepadella patella, Mytilina ventralis, Scardium longicaudum,* are dominant.

The composition of the species and individual numbers of the Rotatoria fauna in the borrowing pits is determinated decisively by the astatik character. Here, correspondingly, the species inclined to be dried up, with a rapid multiplication cycle, can be found.

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A sárospataki Bodrog-hullámtér Rotatoria faunája

BANCSI I.
Alsó Tisza-vidéki Vízügyi Igazgatóság Szolnok, Tiszaliget

Kivonat

A Tisza Rotatoria faunájának rendszeres vizsgálata során mind quantitatív, mind qualitatív viszonylatban jól érzékelhető a mellékfolyók hatása. Ezért szerző megvizsgálta az egyes mellékfolyók és a velük időszakosan kapcsolatos holtágak és kubikgödrök Rotatoria faunáját is. Megállapítást nyert, hogy a Bodroghullámtér e fauna elemekben igen gazdag s az áradások időszakában nagymértékben befolyásolják a Bodrog és ezen keresztüla Tsiza faunájának összetételét is. Megoszlásukat tekintve a tavaszi időszakban a planktonikus-, ősszel a metafitikus fajok bejutásával kell számolni.

ROTATORIA ФАУНА ПОЙМЫ БОДРОГА В ШАРОШПАТОКЕ

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Резюме

В ходе систематического исследования Rotatoria фауны р. Тисы как в количественном, так и в качественном отношениях явно заметно влияниее притоков. Поэгому автор занимался исследованием некоторых притоков и одновременно фауны мёртвых русл и земляных ухаб. В результате установлено, что пойма Бодрога очень богата элементами этой фауны и это в период наводнений оказывает значительное влияние на состав фауны Бодрога а через него и Тисы. Что касается их разделения, в весенний период следует ожидать появления планктонических, а в осенний — метафитических зидов.

Fauna Rotatoria plavnog područja reke Bodrog kod Sárospatak-a

Bancsi I.
Vodoprivredna uprava donje Tise, Szolnok—Tiszaliget

Abstrakt

Kvantitativna i kvalitativna sistematična ispitivanja faune Rotatoria Tise ukazuju na uticaj njenih pritoka. Stoga je autor analizirao faunu Rotatoria pojedinih pritoka, mrtvaja i u kubicima koji su sa njima povremeno povezani. Utvrdjeno je da plavno područje Bodroga ima veoma bogatu faunu Rotatoria i u vreme visokog vodostaja umnogome utiče na sastav faune Bodroga a samim tim i Tise, i to: u toku proleća se javljaju planktonske, a u toku jeseni metafitičke vrste.

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A HISTORY AND PRESENT-DAY SITUATION OF THE INVESTIGATION OF THE RECENT LAND SNAILS IN THE GREAT HUNGARIAN PLAIN

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Abstract

The author is surveying the history of the malacological investigation in the Great Hungarian Plain from 1868 until our days.

The Great Plain belonged to the least explored regions of Hungary, though it is the largest geographical region of the country. Till 1956, not more than 31 publications dealt with the land-snail fauna. The research workers of the fin di siècle and of the early part of our century, mostly geologists: MOCSÁRY, LÓCZY, TÖMÖSVÁRY, TRAXLER, CSIKY, KORMOS, TREITZ, SCHLESCH, carried out mainly sporadic collections at the fringes of the Great Plain, now outside our frontiers. The fauna of the Great Plain is characterized by L. Soós, Rotarides, CZÓGLER, until the end of the nineteen-forties, who relied on the data of seventy sampling sites. They did not perform any investigations on the marshlands and wooded areas, which were in that time still undisturbed and free from draining. The systematical malacological exploration of the Great Plain began in the nineteen-fifties, when the Academical Programme of Tisza Research started. This programme was limited to the inundation area of the Tisza. HORVÁTH, VÁSÁRHELYI and later BÁBA, as members of the Tisza-Research Working Committee, have extended their investigations outside the inundation area of the Tisza, as well. In addition to VÁGVÖLGYI, mainly the students of A. HORVÁTH have joined, apart from BÁBA, since the sixties-seventies, in the research work, in some regions of the Great Plain (GEBHARDT, RICHNOVSZKY, KOVÁCS). The first Hungarian malacological conference, as well, was organized on their suggestion in Szeged.

In the Great Plain 97 species have so far been found, proving that the Great Hungarian Plain may be considered as an impoverished foreground of the Carpathians and Alps (the Drava plain). Of these seven species live only outside our frontiers (Table 1, column 8).

The research of the Great Plain cannot be closed. The systematic elaboration of the plain parts of the neighbouring states, and that of the culture and semi-culture areas, are missing.

Introduction

The Great Hungarian Plain is the largest geographical region of the country. Its largest part is formed by the Plain along the Tisza (PÉCSI 1969).

Its malacological investigation has been, and remained, the poorest among all the other regions. The explanation of this was already given by Soós 1915: "...even those dealing with these were more attracted by the mountainous district, which promised more things of interest, concealed a greater richness than the plain so poor in molluscs". At the same time, at any rate, Soós threw light upon, with his works (1915, 1928) that this fauna was not poor. This has throughly been confirmed by the researches of the latter decades.

In the past twenty years (since 1958), a new light was thrown upon this fauna by my forest investigations, carried out with a quadrating method, which investigations included the Hungarian, Czechoslovak and Rumanian parts of the Great Plain.

The method of elaboration

In addition to my own collections, I have also used the data of authors, publishing about the Great Plain. The documentary material of the collections concerning the Great Plain was namely annihilated by the destruction of the Zoological Department of the National Museum by fire, in 1956. On the basis of the literary data, it turned out that, till the forties, the authors, with the exception of CSIKY 1906 and ROTARIDES 1931, have not summarized the data of one another.

I have also used the journal of collection of CZÓGLER, written between 1915 and 1934, which is in my possession.

I am presenting the data coming from the different parts outside the frontier of the country in nine columns in Table 1.

Owing to the changes in nomenclature in the course of the almost 100 years, the names of species, published by the different authors, were modified, as follows. *Perpolita radiatula* = *Nesovitrea hammonis, Aegopinella nitens* = *Aegopinella minor, Arion empiricorum* = *Arion fasciatus, Oxychilus callarius* = *O. draparnaudi.* I have arranged the taxonomical sequence of the species list of Table 1 and the nomenclature of species according to Pintér's publication (1974). *Vallonia enniensis* (GREDLER 1856) takes place under the name of *V. pulchella.*

History of the malacological research in the Great Hungarian Plain

The first data are published of Nagyvárad and environment in 1868, 1872, 1891 by MOCSÁRY. He is followed by LÓCZY 1886, TÖMÖSVÁRY 1889, TRAXLER 1893, with data from the environments of Temesvár and Munkács. The environs of Budapest are elaborated by HAZAY, 1881. Following their activity, the fauna catalogue of CSIKY 1906 already renders account of 54 land species, unfortunately without exact data of habitat. Of this, 42 species can be accepted as origins really from the Great Plain. Csiky's work contains Westerlund's data (1890), as well, taken over from Hungarian authors, resp. coming from Hungarian exchange material abroad concerning the Great Hungarian Plain. It is stated by CSIKY 1906 that "we don't know entirely the mollusc fauna of the central parts, to which the Great Hungarian Plain belongs, as well; on the other hand, some points of that — mainly the environs of Budapest and Nagyvárad — are known enough".

The data of scattered items, coming from some geologists, working in the fringe areas of the Great Plain, were not yet published by CSIKY at the beginning of this century. Thus, he published neither the collection by KORMOS 1904, nor that by TREITZ 1909, from Püspökfürdő, resp. Palics.

KERTÉSZ 1890, 1901, and DUDINSZKY 1907 are publishing aquatic species, their data do, therefore, not take place in my Table.

L. SOÓS deserves credit for having turned—in conformity with the instructions of the Hungarian Geographical Society — his attention to the Great Plain and collecting between 1909 and 1911 on several points of the Great Plain at seventy sites (on the basis of the works of SOÓS 1915, ROTARIDES 1931, SOÓS 1943, 1956). He first summarized his works (in answer to Sturany-Wagner's work, 1914) in 1915. He used the scattered data of other collectors (CSIKY, ENDREY, GYŐRFFY, HAZAY, HORVÁTH, KERTÉSZ, ÚJHELYI), as well. Of the collections, summarized here, the data of 25 collecting places on the part of the Great Hungarian Plain outside the national frontiers.

My Table published here also encloses the data of MOCSÁRY and KERTÉSZ on the slugs collected by them. These were, namely, omitted by SOÓS. He wrote: "because

of omitting the shell-less forms, I have also omitted the data of MOCSÁRY and KERTÉSZ referring hereto". Soós could not collect slogs owing to aridity.

The fringes of the Great Plain let know very much of the fauna of the Great Plain of yore. On the one hand, they afford the proofs of the dispersion to the Great Plain. On the other hand, the forest fauna, the remains of which are recognized by Soós in the fauna of Bátorliget (Soós 1928), could then be found just in the fringe areas of the Great Plain (e.g, in the first part of the century, the environment of Mohács and the plain at Bereg—Szatmár belonged to an almost continuous forest area).

The later works of Soós concerning the Great Plain were inspired by a faunistical publication of DUDICH 1926.

Later on, Soós's attention turned towards the past of the Hungarian mollusc fauna (Soós 1926), at which he takes into consideration the data coming from the fringe of the Great Plain, resp. from the mountainous areas (Transylvania). The main merit of this work is the observation of faunal history (KROLOPP 1973).

Soós's attention was attracted, later on, in the course of his research work in the Great Plain, by the exploration of the fauna at Bátorliget. Answering to the establishments of DUDICH 1926, he writes his recent works (1927, 1928). In the debate, both of them reach at a right knowledge. DUDICH recognizes the role of subsoil water, moving close to the surface, as the main factor. SOÓS, referring to the reconstruction of the plain vegetation by RAPAICS 1925 and KAÁN 1927, establishes that Bátorliget is a remainder of an earlier forest phase of the Great Plain. As he writes, "we may conclude, of full right, that in the old humid Great Plain with forests, groves, lived a similar fauna to that of the present-day Bátorliget, or even richer".

However they reached knowledge, demonstration was, unfortunately, missing. Although in the nineteen-twenties, a high number of forests, preserving a similar fauna, may have existed in the Great Plain: in the Nyír (a district in north-eastern Hungary), in Szatmár—Bereg, and even in the area Turjánvidék. The intensive draining of subsoil water began namely only in the thirties.

Following Soós's work (1915), two newer malacologists began working in the Great Plain: CZÓGLER (in his collecting diary, led from 1915, the last note is in 1934), as well as Rotarides. Both collected the water and land fauna of Szeged and its wider environs. Some recent data are published by Schlesch 1929, as well. Rotarides is the first who, as the first member of Gelei's school of ecological point of view, approaches the molluscs of the Great Plain (ROTARIDES 1926 a, b, 1928). He mentions first the "exchange fauna" of water-edges, but he recognizes spreading by water only in case of some species. He refers to the effect of drainage and cultivation of the Great Plain in making the fauna island-like, as a result of which the mass of the surviving species consists of ubiquitous organisms. He exposes the fauna of the forest at Kistelek and Deszk, collected since then; establishes that the "ribbon" variations of the *Cepaea* species are induced by their interaction with the environment. The species could be used, at present, too, for inducing a change in the environment. Rotarides, getting connected with the work of the Plain Research Committee in Szeged, discovered the fossil fauna of the loess soils in the neighbourhood of Szeged, not forgetting the recent fauna, either (ROTARIDES 1927, 1931, 1932). Then he drew up the list of the mollusc fauna in Hungary, in which the data from the Great Plain get a place, as well (ROTARIDES 1933).

In the meantime, there were some informations about the fauna of the environs of Szeged, from ecofaunistical point of view by CZÓGLER 1927, 1935. CZÓGLER 1927 was only dealing with shell-fish. (The picture of Rotarides and Czógler about the fauna of the Great Plain is to be seen in Table 1, column 4).

FINALLY, CZÓGLER, ROTARIDES 1938 analyse the deposit fauna of the Tisza and Maros. They recognize the role of water in the distribution of the fauna. Their investigations are, however, localized to the environs of Szeged.

In the nineteen-thirties, WAGNER publishes some data of the Great Plain only in connection with a few species. He gave a description (later proved erroneous) of a new species (1933 a, 1935 b, c, d) and then wrote of the distribution of the Pomatias genus in 1938.

Soós 1943, 1956 summarizes the knowledge referring to the mollusc fauna in the Carpathian basin. His principal work is, of course, containing the data of the Great Plain, as well.

With this, the activity investigating into the Great Plain of the three great malacologists of the beginning of our century (ROTERIDES, SOÓS, WAGNER) is closed. Of their 240 monographs of malacological subject 17 were dealing with the Great Plain. Even the number of the papers of malacological subject, dealing with the Great Plain since 1872 was not more than 31 (a number of these are, however, dealing with aquatic fauna, as well.)

Rotarides's student, A. HORVÁTH, dealt with molluscs in Szeged since 1940. His main merit is, to have recognized the importance of the systematic Tisza Research among the first researchers (BÁBA 1973). Before drawing attention to the research of the animal kingdom of the Great Plain (SZENTIVÁNYI 1944—1945), he wrote eight papers, mainly in connection with the Tisza. These deal, for the most part, with the aquatic fauna of the Tisza and its dead arms. Land snails are treated by HORVÁTH 1950, 1955, 1957, 1958, 1962. His ecofaunistical works give valuable dates to the knowledge of snails in the inundation areas of the Tisza valley. He classifies the different species on the basis of their humidity and temperature demands. He deals with the effect of draining on the formation of the environment. In respect of Bátorliliget, he brings the opinions of Dudich and Soós nearer to each other. He writes: "...the mollusc fauna of the Great Plain preserved, besides the Holocene changes, a number of Pleistocene qualities in the primeval bogs (HORVÁTH 1954) (!?)

In his papers, treating Pleistocene snails from the Danube—Tisza interstream region (HORVÁTH—ANTALFI 1954, HORVÁTH 1962, 1963, 1964, 1965, 1966, 1972), he uses his ecological observations, too, concerning the species from the Tisza valley.

In 1956—1957, the organized Tisza-research work in the framework of the Tisza-Research Working Committee, began with Academical support, led by Prof. KOLOSVÁRY.

In the work of the Working Committee I have also participated from its beginning, on the proposal of A. HORVÁTH, and my work has included the forests of the Great Plain. Cf.: BÁBA 1958, 1962 a, b, 1964, 1965, 1966, 1968, 1969 a, b, c, 1970, 1971, 1970—71 a, b, 1972, a, b, 1973 a, b, 1974 a, b, c, d, 1975 a, b, sc, d, 1977 a, b, d, 1978, 1979 (these publications deal only with land snails).

The Tisza deposit fauna is analysed by VÁSÁRHELYI 1958, on the basis of his collections from the Upper and Middle Tisza. The non-published data of his collections, concerning the Great Plain, were reviewed by the elaborator of his collections, VARGA, in 1979.

Vágvölgyi's paper (1953) is extremely informative from methodical point of view, as well. In the course of reelaborating the snail fauna of Bátorliget, he already deals with the dominance relations, too. He carries out his collections in plant-coenological units, summarizing also the sporadic collections of Z. KASZAB, V. SZÉKESSY, GY. ÉHIK, Mrs. KISS-KOCSIS, Mrs. G. FEJÉRVÁRY, J. STILLER, G. GERE, G. ZILAHI-SEBESS.

From the nineteen-sixties and seventies, parallel with my investigations, more and more people have joined in the malacological research work, mainly in connection with some regional units of the Great Plain. Particularly, the activity of some students of A. HORVÁTH is considerable.

The elaboration of the Danube valley and the Drava-flat was the first (GEBHARDT 1961). The: RICHNOASZKY 1962, RICHNOVSZKY-KOVÁCS 1962, RICHAOVSZKY 1963, 1967, 1973, RICHNOVSZKY—ZEISSLER 1968. (From the above-listed papers those dealing with aquatic snails are missing). I. PINTÉR 1962 gives an exact survey of the distribution of *Cepaea* species in this country.

From among the specialists of the University in Debrecen, BOGNÁR 1969 gives coenological data from the flood-plain groves of the Danube at Baja. M. TÓTH 1971—1973, 1975 elaborates the molluscs of the inundation area of the Bodrog at Sárospatak and studies the molluscs of Haláp.

Horváth's student, KOVÁCS 1974, gives some faunistical knowledge of the molluscs in the environs of Békéscsaba. He also publishes the data from. A. Varga's collections in County Békés. He finds a new species *(Ochychilus hydatinus)* in the fauna of our country.

AGÓCSY 1965, 1966, 1968 also publishes some data of the Great Plain (his data from the Nyír, from the area between the Duna and Tisza rivers are only published by PINTÉR—RICHNOVSZKY—SZIGETHY 1979). He investigates, how the occurrence of the single species can be inserted in the climate district classification of Thornthwaite concerning our country.

L. PINTÉR 1962, 1967, 1970 and his student, A. SZIGETHY 1973 clarify, in connection with their fauna-revising activity, on the basis of the data being at their disposal, the proper anatomical-taxonomic place and distribution of the single genera and species. VARGA—PINTÉR 1972 describe a new species, found in Kovács's new collections, from the southern part of the Great Plain *(Hygromia kovacsi)*.

In 1971, the malacologists of the southern Great Plain (HORVÁTH, BÁBA, RICHNOVSZKY, KOVÁCS, HORNUNG, SZEKERES) arranged a meeting in Szeged. In the Summer of 1972, in Baja, on their suggestion, the malacologists working in the country had a meeting, resolving the systematical exchange of information and organizing the systematic research of the fauna (BÁBA 1974). As a result of this, the journal Soósiana has been published. And on the basis of the common processing of the recent data of distribution after 1950, as secord in the World, the monograph: PINTÉR—RICHNOVSZKY—SZIGETHY 1979: The present-day situation of the malacological research in the Great Plain was published, according to the system U TM, with faunalistical distribution maps.

From the fauna of the Great Hungarian Plain no full picture can be made, even today. The systematic elaboration of the flat parts of Czechoslovakia, Rumania, Jugoslavia, and the Soviet Union (Sub-Carpathia or Ruthenia) is missing. About this, the collections from the beginning of this century could only give some loose survey. My own collections 1970, 1972—1973 from Rumania, Czechoslovakia also give only a little contribution to knowledge (Eastern Slovak Plain, Rumanian part of the Nyír, Temesköz, the area along the Maros).

The investigation into the Great Hungarian Plain can also not be closed. The areas under forest culture, planted forests, banks of canals, investigated only a little by me, can faunistically yield some interesting problems. Good examples for this are the two living individuals of *L. plicata,* collected by I. MAHUNKA in Újszentmargita in 1977, as well as the collections of GY. KOVÁCS, carried out in the different semiculture areas (parks of manor-houses, banks of canals and rivers) and culture areas

Table 1. *Phases of knowing the snail fauna of the Great Hungarian Plain from the beginning of the century until our days*

	1	2	3	4	5	6	7	8	9
Pomatias elegans (O. F. MÜLLER 1774)				+				X	
Pomatias rivulare (EICHW. 1829)		+	+		+			X	+
Aricula polita (HARTM. 1840)	+		+		+			+	
Carychium minimum (O. F. MÜLLER 1774)		+	+		+	+	+	×	+
Carychium tridentatum (RISSO 1826)					+		+	×	
Cochlicopa lubrica (O. F. MÜLLER 1774)	+	+	+	+	+	+	+	×	+
Cochlicopa lubricella (PORRO 1837)					+		+	×	
Columella edentula (DRAP. 1805)				+	+			×	
Truncatellina cylindrica (FER. 1807)		+	+	+	+	+	+	×	+
Truncatellina claustralis (GREDLER 1856)					+			+	
Vertigo augustior JEFFR. 1830		+	+		+			×	+
Vertigo pusilla O. F. MÜLL. 1774					+			×	
Vertigo antivertigo (DRAP. 1801)		+	+	+	+		+	×	+
Vertigo moulinsiana (DUPUY 1849)	+	+		+	+			+	
Vertigo pygmaea (DRAP. 1801)		+		+	+	+	+	×	+
Orcula doliolum (BROUG. 1972)							+	×	
Granaria frumentum (DRAP. 1801)	+	+	+	+	+	+	+	×	+
Pupilla muscorum (L. 1758)	+	+	+	+	+	+	+	×	+
Pupilla sterri (VOITH 1838)								×	
Vallonia pulchella (O. F. MÜLLER 1774)	+	+		+	+	+	+	×	+
Vallonia costata (O. F. MÜLLER 1774)	+	+	+	+	+	+	+	×	+
Acanthinula aculeata (O. F. MÜLLER 1774)					+		+	×	
Chondrula tridens (O. F. MÜLLER 1774)	+		+	+	+	+	+	×	+
Ena obscura (O. F. MÜLLER 1774)								×	
Zebrina detrita (O. F. MÜLLER 1774)		+		+				+	+
Cochlodina laminata (MONTAGU 1803)	+	+	+	+	+	+		×	
Ruthenica filograna (ROSSM. 1836)			+					+	
Macrogastra ventricosa (DRAP. 1801)				+		+		+	
Macrogastra latestriata (A. SCHMIDT 1857)	+								+
Clausilia dubia DRAP. 1805				+		+		+	
Clausilia pumila C. PFEIFF. 1828			+		+			×	
Lacinaria plicata (DRAP. 1801)	+	+			+			×	+
Laciniaria biplicata (MONTAGU 1803)		+		+		+		×	+
Succinea putris (L. 1758)	+	+		+	+	+		×	+
Succinea oblonga DRAP. 1801	+	+	+	+	+	+	+	×	+
Succinea elegans RISSO 1826	+	+		+	+	+	+	×	+

	1	2	3	4	5	6	7	8	9
Cecilioides acicula (O. F. MÜLLER 1774)		+		+		+	+	×	+
Punctum gygmaeum (DRAP. 1801)		+			+	+	+	×	
Discus rotundatus (O. F. MÜLLER 1774)	+		+					+	+
Arion hortensis FER. 1819	+	+		+			+	×	+
Arion circumscriptus JOHNSTON 1828			+		+	+	+	×	×
Arion fasciatus (NILSSON 1822)	+	+		+				+	+
Arion subfuscus DRAP. 1805	+			+		+		×	×
Vitrina pellucida (O. F. MÜLLER 1774)		+			+	+	+	×	
Zonitoides nitidus (O. F. MÜLLER 1774)	+	+	+	+	+	+	+	×	+
Vitrea crystallina (O. F. MÜLLER 1774)	+	+	+	+	+	+	+	×	
Vitrea diaphana (STUD. 1820)						+		×	
Aegopis verticillus (LAM. 1822)						+		+	
Aegopinella pura (ALDER 1830)			+	+				×	
Aegopinella minor (STABILE 1864)	+	+	+		+	+	+	×	+
Aegopinella ressmani (WEST. 1883)						+		×	
Nesovitrea hammonis (STRÖM 1765)							+	×	×
Oxychilus draparnaudi (BECK 1837)				+			+	×	
Oxyhilus hydatinus (RM. 1838)							+	+	
Oxyhilus glaber (RM. 1835)	+	+	+		+	+		×	+
Oxychilus inopinatus (ULIČNÝ 1887)				+			+	×	
Daudebardia rufa (DRAP. 1805)						+		×	
Daudebardia transsylvanica (CLESSIN 1877)	+							+	+
Daudebardia calophana (WEST. 1881)								×	×
Milax rusticus (MILLET 1843)	+							+	+
Milax budapestiensis (HAZAY 1881)							+	+	
Limax nyctelius BOURG. 1861								×	
Limax tenellus O. F. MÜLLER 1774							+	×	
Limax maximus L. 1758	+		+	+	+			×	+
Limax cinereoniger WOLF 1803	+	+				+		×	×
Limax flavus L. 1758				+			+	×	
Bielzia coerulans (M. BIELZ 1851)								+	+
Lehmania marginata (O. F. MÜLLER 1774)	+	+						×	+
Deroceras laeve (O. F. MÜLLER 1774)				+		+		×	
Deroceras reticulatum (O. F. MÜLLER 1774)						+		×	×
Deroceras agreste (L. 1758)	+	+		+		+	+	×	×
Euconulus fulvus (O. F. MÜLLER 1774)	+	+		+	+	+		×	+
Bradybaena fruticum (O. F. MÜLLER 1774)	+	+	+	+	+	+		×	+
Helicella obvia (HARTM. 1828)	+	+	+	+	+	+	+	×	+
Helicopsis striata (O. F. MÜLLER 1774)	+	+		+			+	×	

	1	2	3	4	5	6	7	8	9
Monacha cartusina (O. F. MÜLLER 1774)	+	+	+	+	+	+	+	×	+
Perforatella bidentata (GM. 1788)		+	+	+		+		×	+
Perforatella dibothrion (M. KIM. 1884)								×	
Perforatella rubiginosa (A. SCHMIDT 1853)	+	+	+	+	+	+	+	×	+
Perforatella incarnata (O. F. MÜLLER 1774)				+	+	+		×	
Perforatella vicina (RM. 1842)			+	+	+			×	
Perforatella umbrosa (C. PFEIFFER 1828)				+		+		+	+
Hygromia transsylvanica (WEST. 1876)								×	
Hygromia kovacsi VARGA—PINTÉR 1972							+	×	
Trichia unidentata (DRAP. 1805)				+		+		×	+
Trichia striolata danubialis (CLESSIN 1874)		+		+		+		×	+
Trichia hispida (L. 1758)	+	+		+		+		×	
Trichia villosula (RM. 1838)	+	+						+	+
Euomphalia strigella (DRAP. 1801)	+	+	+	+	+	+	+	×	+
Helicigona banatica (RM. 1838)		+		+	+			×	+
Helicigona arbustorum (L. 1758)	+	+		+		+		×	+
Isognomostoma isognomostoma SCHRÖTER 1784								×	
Cepaea vindobonensis (FER. 1821)	+	+	+	+	+	+	+	×	+
Cepaea nemoralis (L. 1758)						+		×	
Cepaea hortensis (O. F. MÜLLER 1774)	+	+				+		×	+
Helix pomatis L. 1758	+	+		+	+	+	+	×	+
Helix lutescens RM. 1837	+	+	+		+		+	×	+
Sum total:	42	48	32	51	48	49	42	97	54
till —1—4		69							
till —5—7		77							

Meaning of the single columns of the Table:

1. MOCSÁRY, TÖMÖSVÁRY, WESTERLUND, HAZAY, Collections from CSIKY (1892—1906).
2. KORMOS, TREITZ, SOÓS 1906—1915).
3. DUDICH, SOÓS, collections from Bátorliget (1925—1928).
4. CZÓGLER, ROTARIDES, SCHLESCH, SOÓS, WAGNER (1915—1943).
5. AGÓCSY, HORVÁTH, VÁGVÖLGYI, SOÓS (1943—1956).
6. BOGNÁR, GEBHARDT, RICHNOVSZKY in Danube valley, Drava plain (1956—1972),
7. KOVÁCS, TÓTH, A. VARGA, VÁSÁRHELYI, (County Békés, the Nyir, till 1974).
8. Summarized fauna of the Great Hungarian Plain. Own collections marked by x.
9. Species occurring in the part of the Great Plain outside of the border of the country.

of County Békés (acacia groves, environs of fish-ponds, cemeteries, town parks, hothouses, etc.)

It is proved by the 97 species, taking place in the summary that the Great Hungarian Plain can be regarded as the impoverished foreground of the Carpathians and Alps (Drava-flat). From among the species listed in column 8, *Pupilla sterri, Orcula*

doliolum, Vitrea diaphana, Laciniaria plicata, L. biplicata, Trichia unidentata, Trichia striolata danubialis, Isognomostoma isognomostoma are expressly living but accidental elements, carried by the river water. *Zebrina detrita* was found in Soós's collection from Kalocsa and Verbász. Its occurence in the Great Plain is dubious. *Macrogastra latestriata, Dandebardia transsylvanica; D. calophana* (BÁBA 1972), *Milax rusticus Trichia villosula* only occured in the parta outside the frontier of the country.

*

The paper will be continued together with References.

Az Alföld malakológiai kutatásának története és mai helyzete

BÁBA K.

A szerző 1968-tól napjainkig áttekinti az Alföld malakológiai kutatásának történetét.

Kivonat

A Nagyalföld faunájáról ma sem alkothatunk teljes képet. Hiányzik Csehszlovákia, Románia, Jugoszlávia és a Szovjetunió (Kárpátalja) alföldi részeinek rendszeres feldolgozása. Erről a század eleji gyűjtések csak áttekintő képet adhattak. Saját 1970, 1972—73. romániai, csehszlovákiai gyűjtéseim is csak egy-egy adalékot nyújtanak a megismeréshez (Kelet Szlovák Alföld, Nyírség romániai része, Temesköz, Maros mente).

A Magyar Alföld kutatása se zárható le. Az általam kevéssé vizsgált, erdőgazdasági művelés alá eső területek, telepített erdők, csatornapartok még több érdekességet nyújthatnak faunisztikailag. Erre jó példa a MAHUNKA I. által Újszentmargitán gyűjtött L. plicata 2 élő példánya 1977-ben, valamint KOVÁCS GY. Békés megye különböző félkultúr (kastélyparkok, csatorna, folyópartok) és kultúr területein (akácosok, halastavak környéke, temetők, városi parkok, üvegházak, stb.) végzett gyűjtései.

Az összesítésben szereplő 98 faj azt bizonyítja, hogy az Alföld a Kárpátok és az Alpok (Drávasík) elszegényedett előtereként fogható fel. A 8 oszlopban felsorolt fajok közül a *Pupilla sterri, Orculadoliolum* kifejezetten folyóvízhordta véletlen elemek. A *Zebrina detrita* Soós gyűjtéséből került elő Kalocsáról és Verbászról. Léte az Alföldön kétséges. A *Macrogastra latestriata, Dandebardia transsylvanica, D. calophana* (BÁBA 1972), *Milax rusticus, Trichia villosula* csak az országhatáron kívüli részekről került elő.

ИСТОРИЯ И СОВРЕМЕННОЕ СОСТОЯНИЕ МАЛАКОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ АЛФЁЛЬДА

К. Баба

Резюме

Автор рассматривает историю малакологических исследований Алфёльда с 1968 года до наших дней.

Относительно фауны Большой Европейской низменности и в настоящее время нет полного представления. Нет систематической разработки низменных районов Чехословакии, Румынии, Югославии и Советского Союза. (Карпатский хребет). Собранные здесь в начале столетия коллекции дают лишь обзорное представление. Некоторый вклад представляют коллекции автора, собранные в Румынии и Чехословакии в 1970, 1972—73 гг. (Восточно-Словацкая низменность, румынская часть Ниршега, Темешкёз, подережье Мароша).

Следует продолжать исследования и в Венгерской низменности. Много интересного могут дать фаунистике менее исследованные автором подлежащие ведению лесного хозяйства территории, лесонасаждения, берега каналов. Хорошим подтверждением этого являются обнаруженные И. Махунка в 1972 году в районе Уйсентмаргит 2 живых образца L. plicata, а также результаты исследований Д. Ковач, собранные им на различных полукультурных (парки бывших дворцов, берега рек, каналы (и культурных) насаждения акаций, районы рыбных озёр, кладбища, городские парки, теплицы и т.д.) территориях обл. Чонград коллекции.

Собранные в общей сложности 98 сортов свидетельствуют о том, что Алфёльд следует признать обедневшим преддверием Карпат и Альп (равнина Дравы). Из перечисленных в восьми столбцах водов Pupilla sterri, Orcula doliolum являются случайными элементами, занесенными сюда водой рек.

Zebrina detrita попала из коллекции Шоша районов Калача и Вербас. Наличие в Алфёльде является спорным. Macrogastra latestriata, Dandebardia transsylvanica, D. calophana (Баба, 1972), попали сюда только из-за границы. Milax rusticus, Trichia villosula

Istorijat i dana nje stanje malakolo kih istra ivanja u Panonskoj niuiji

Bába K.

Abstrakt

Autor daje pregled malakoloških istraživanja u Panonskoj niziji od 1968. godine do danas.

O fauni Panonske nizije do danas nemano potpunu sliku. Nedostaje sistematska obrada faune sa područja ćehoslovačke, Rumunije, Jugoslavije i nizijskog dela Zakarpatskog područja SSSR. Sopstven materijal prikupljen u toku 1970, 1972—73. sa područja ćehoslovačke (nizija istočne Slovačke) i Rumunije (Nyírség, Temesköz, područje Marosa) takodje su samo prilog upoznavanju faune.

Ni istraživanja madjarskog dela Panonske nizije nisu okončana. Sopstvena sporadična ispitivanja površina pod šumama, plantažnih šuma, pošumljenih deponija kanala, mogu dati još dosta interesantnih podataka u faunističkom pogledu.

Prikazanih 98 vrsta ukazuju na osiromašenje faune na području Panonske nizije, Karpata i Alpa (područje Drave). Medju utvrdjenim vrstama *Pupilla sterri, Orcula doliolum* su slučajni, sa vodotokom prispeli elementi. *Zebrina detrita* je konstatovana u zbirci Soós-a iz okoline Kaloče i Vrbasa. Njegovo prisustvo u Panonskoj niziji je sporno. *Macrogastra latestriata, Dandebardia transsylvanica,* D. calophana (Bába 1972), *Milax rusticus, Trichia villosula* prikupljeni su samo sa područja preko državne granice.

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RELATION BETWEEN BODY WEIGHT AND BODY LENGTH OF THE WELS OR WALLER (SILURUS GLANIS L.) IN THE TISZA REACHES AT TISZAFÜRED

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(Received 20 November, 1979)

Abstract

On the basis of the data, collected about 220 wels individuals in the period between 1974 and 1978, concerning the relation between weight and length the following connection was given:

$$\lg W = -5.1532 + 3.0006 \cdot \lg L,$$

where the body weight (W) is given in g, the body length (L: standard length) in mm. Comparing this with the data representing the average in Hungary, it is to be established that the welses in the Tisza begin with a smaller weight but the tempo of the increase in their weight is better than the average.

Introduction

In case of fish populations it may be very important to know the allometric relation between body weight and body length. From the point of view of production it is not all the same, either, what the average body weight of the single populations is in case of an identical body length. The aim of the investigation, carried out on the mandate of the Hatchery and Research Institute for Pisciculture, Szarvas, was to become acquainted with the condition of the welses in the Tisza.

Material and Method of the investigation

We have used to the investigation the data of 220 wels individuals. The fishes were caught in the Tisza reaches at Tiszafüred, between 1974—1978. Their body length (measured from the tip of the nose till the beginning of the caudal fin) changed between 350 and 1740 mm, their body weight fell between 300 and 42150 g.

I have expressed the relation of length and weight with the formula suggested by Tesch (1968):

$$W = a \cdot L_b$$

resp. with the connection, given by the logarithmic form of this:

$$\lg W = \lg a + b \cdot \lg L$$

W is the body weight of the fish, L is the body length and "a" and "b" are the parameters of the equation.

I have calculated the values of the condition factor (CF) according to Hile (1936), on the basis of the connection:

$$CF = \frac{W}{L^3}$$

Results

After performing the linearity investigation with the logarithms of data, I fitted a line to the points, with the least square method (Fig. 1). The equation of the received line is:

$$\lg W\ 2-5.1532+3.0006 \cdot \lg L$$

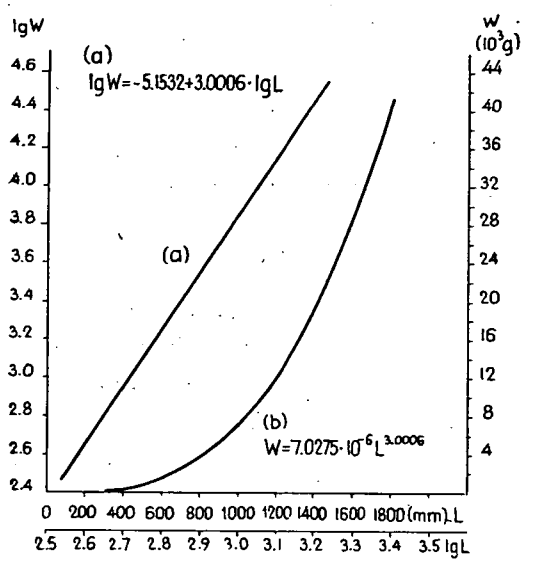

Fig. 1. Allometric relation between body weight and body length W = body weight ing L = body length in mm.

From the equation the body weights, belonging to the single body lengths, can be calculated and compared with Antos's (1970) data (Table 1).

Table *1. Connection between the body length and body weight of the wels*

Body length in mm	Body weight in g	
	Hungary	The river Tisza
500	1 300	880
800	400	3 600
1100	10 000	9 400
1450	20 000	21 500
1750	35 000	37 700

Antos does not publish the exact origin of his data but these supposedly represent the average in Hungary.

It turns out of the Table that the body weight of the rather small individuals, which form the bulk of the catching in the Tisza, remains below the average. They begin, therefore, with a smaller weight but the tempo of their growing in weight is faster than that of the average.

The weight data of Antos are probably strongly rounded values. Thus, the CF values, calculated of these, are also approximative (Table 2). With the increase in body length, they perceptibly decrease, while the condition of the welses in the Tisza is balanced enough.

Table 2. *Condition of the average welses in Hungary and in the Tisza*

Body length (mm)	10^5 CF	
	Hungary	Tisza
500	1.040	0.704
800	0.781	0.703
1100	0.751	0.706
1450	0.656	0.705
1750	0.653	0.703
	.....	

From the point of view of meat production it is decisive, after all, in how much time the given body weight was achieved by fishes. This question, however, will only be replied to by the growth investigation, as a function of time.

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A harcsa (Silurus glanis L.) testsúly-testhossz viszonya a Tisza folyó tiszafüredi szakaszán

HARKA Á.

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Kivonat

Halpopulációk esetében igen fontos adat a testsúly és a testhossz allometrikus viszonyának ismerete. Szerző 1974 és 1978 közötti időszakban 220 harcsapéldányt mért meg s ennek alapján a súly és a hossz viszonyára a következő összefüggést mutatta ki:

$$1 \text{ g } W = 5{,}1532 + 3{,}0006 \cdot \lg L$$

ahol a testhossz (W) g-ban a testhossz (L standarthossz) mm-ben szerepel. Összehasonlítva a magyarországi átlagot képviselő adatokkal megállapítható, hogy a tiszai harcsa példányok kisebb súllyal indulnak, de súlynövekedésük üteme az átlagosnál jobb. A halhústermelés szempontjából azonban az a döntő, hogy az adott testsúlyt mennyi idő alatt érik el a halpéldányok. Erre azonban csak az idő függvényében végzett növekedésvizsgálat fog választ adni.

СООТНОШЕНИЕ ВЕС ТЕЛА-ДЛИНА ТЕЛА ЩУКИ (SILURUS GLANIS L.) НА УЧАСТКЕ ТИСЫ У ТИСАФЮРЕДА

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Резюме

В случае рыбных популяций важным показателем является аллометрическое отношение между весом и длиной тела. В период с 1974 по 1978 гг. автор провёл измерения 220 щук и на основе этих измерений составил следующую формулу соотношения веса и длины тела:

$$\text{I g w} = 5{,}1532 + 3{,}0006.\ \text{Ig L}$$

где вес тела (w) выражен в г,а
длина (*йй* станд.длина) — в мм.

При сравненнии полученных автором данных измерений со средними по Венгрии, установлено, что экземпляры щук в Тисе отличаются меньшим начальным весом, но темп прироста живого веса у них выше среднего. С точки зрения рыбопроизводства основным моментом является то, за какое время экземпляры рыбы способны достичь определённого веса. Ответ на этот вопрос даст анализ прироста в зависимости от времени.

Odnosi težine i dužine soma (Silurus glanis L.) na deonici Tise kod Tiszafüred

Harka A.
Gimnazija Kossuth Lajos, Tiszafüred

Abstrakt

Poznavanje alometrijskih odnosa težine i dužine tela ribljih populacija je od velikog značaja. Autor je u periodu 1974—1978 premerio 220 jedinki i na osnovu odnosa težine i dužine utvrdio sledeću zavisnost:

$$1\ \text{g W} = 5{,}1532 - 3{,}0006.\ 1\text{g L}$$

gde je težina (W) data u gramovima a dužina (L standardna dužina) u mm. Uporedjujući sa prosecima iz Madjarsje može se utvrditi da i pored toga što somovi iz Tise u početku imaju manju težinu tempo porasta u težini im je bolji od proseka. Medjutim sa stanovišta proizvodnje ribljeg mesa odlučujuće je za koje se vreme dostiže data težina pojedinih jedinki. Na ovo pitanje će dati odgovor ispitivanja porasta u funkciji vremena.

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THE COMPARATIVE ORNITHOLOGICAL INVESTIGATION INTO THE FLOOD-PLAIN MEADOW AT TISZALÖK AND RAKAMAZ

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(Received 10 November, 1979)

Abstract

The paper compares the avifaunas of the flood-plain meadows at Rakamaz and Tiszalök. I have established in the course of the systematic stock-takings the number of the nesting species and pairs. In connection with these and the analysis of the observed ecological changes, I have established the following:

1) The areas are degraded as a results of human effects.

2) As a result of afforestation, foreign — mainly arboricolous and dendricolous — species settle down in the area of the meadow.

3) In the flood plain of the Tisza, some areas preserving original floral and faunal elements can also be found.

4) The meadow at Rakamaz is like this, too; its protection would, therefore, be worth while and reasonable.

Introduction

The continuous research, observation of our rivers and among these the Tisza is justified by the permanent transforming human activity. As a result of these effects, the fall of the river, the direction of flowing, the dimension of flood plain, etc. change. In the area, restricted within banks — though here mostly an agricultural activity is going on — there are still some sections, which preserved more or less of the bygone animal and vegetable kingdoms. But the dimension of these areas decreases more and more, it is therefore important to observe and take them into consideration. It is therefore that I chose — after previous information — the flood-plain meadows at Rakamaz and Tiszalök. We can namely get — after duly investigating and comparing them — a certain picture of the causes, direction and degree of the changes to be expected. These meadows are the most characteristic ecosystems of these Tisza reaches, because here have been forests of major dimension neither today, nor in the past. My decision is justified by this, as well.

Natural conditions

I) The flood-plain meadow at Rakamaz lies south of the railway line connecting Tokaj with Rakamaz, its extent being about 900 ha (cf. Fig. 1). Its surface is flat, having the lone and mostly silted up mortlake beds as terrain depressions.

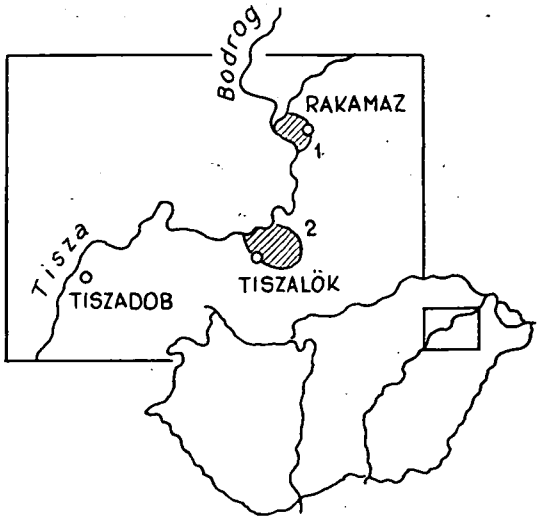

Fig. 1. Geographical situation of the investigated areas in Hungary.

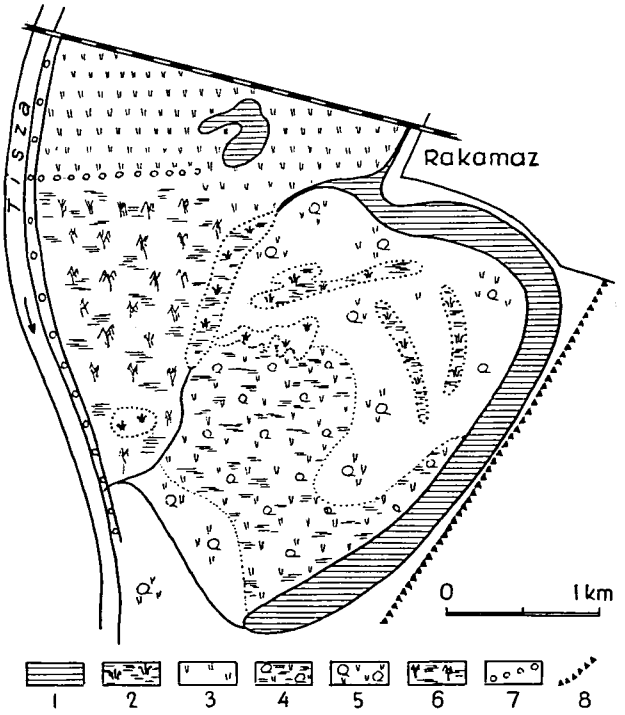

Fig. 2. Distribution of the nesting biotopes in the flood-plain meadow at Rakamaz
Key to the signs used: 1 Mortlake 2 Swamp 3 Grazing land 4 Meadow with willow bushes and puddles 5 Dry meadow with willow bushes 6 Bleak grass-land with puddles 7 Row of trees 8 Dike.

Despite grazing and mowing, the vegetation has preserved much of its former state. I perform the botanical analysis of the meadow as an ecosystem in nesting biotopes, but only in a depth necessary from ornithological point of view. (Cf. Fig. 2).

1) The mortlake — mostly with a free water surface, at the surface with a floating vegetation — *Nymphoidetum alboluteae.* There are several *Typha angustifolia,* a few *T. latifolia, Glyceria maxima, Phragmites communis,* with narrow reed-fringes towards the meadow. Here and there, there are several *Schoenoplectus lacustris,* in spots.

2) In the mortlake beds, already filled up for the most part, marshes were formed where the stock-forming species are *Glyceris maxima* and *Schoenoplectus lacustris.* There are comparatively few *Typha latifolia* and *Phragmites communis.*

3) The grazing land is generally the highest part of the area, becoming dry at first, where owing to the continuous treading and grazing the vegetation became poorer and degraded. The basis is here, too, the *Lythro-Alopecuretum pratensis* association but with much fewer species. Stock-forming is *Alopecurus pratensis.* There are characteristic: *Poa pratensis, Rumex conglomeratus,* in fresher places *Symphytum officinale* and *Ranunculus sceleratus.*

4) The most characteristic biotope — and scenic element — of the area is the meadow with willow-bushes, where rich bush groups are sporadically formed by *Salix alba.* Here and there, in the deeper parts, temporary puddles are formed with an *Eleocharis acicularis, Carex vulpina, Agrostis stolonifera,* and *Symphytum officinale* vegetation.

5) In the higher and dry parts of the willow-bush areas a characteristic flood-plain meadow: *Lythro-Alopecuretum hungaricum* was formed, with *Alopecurus pratensis, Poa pratensis, Trifolium pratense, Chrysanthemum leucanthemum, Leucojum aestivum, Equisetum arvense* and in fresher places *Symphytum officinale* and *Ranunculus sceleratus* species.

6) The vegetation of the grass-land without willowy bushes completely agrees with the former, only *Salix alba* is missing.

7) The area is comparatively poor in trees, at least much poorer than the meadow at Tiszalök. Its only row of trees is formed by planted *Populus robustus.*

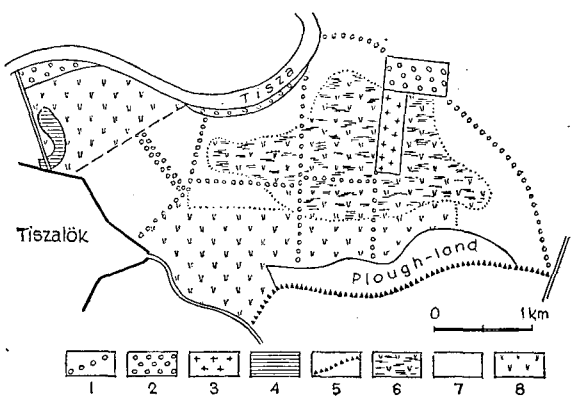

Fig. 3. Distribution of the nesting biotopes in the flood-plain meadow at Tiszalök
Key to the signs used: 1 Row of trees 2 Forest belt 3 Willow plantation 4 Mortlake 5 Dike 6 Meadow with puddles 7 Dry meadow — grass-land 8 Dry meadow — grazing Land

II) The flood-plain meadow at Tiszalök similarly lies at the left bank of the river, east-northeast of Tiszalök, its extent being about 970 ha (cf. Fig. 1). In respect of its character, it differs from the former meadow. It has more rows of trees and even a forest belt. By human impacts deeper changes are caused and this is manifest both in its vegetation and in the animal kingdom (cf. Fig. 3).

1) The row of trees and the forest belt consists of a 20 to 25 years old planted *Populus robusta* stock.

2) At the side of the channels, covering with a network the area, a characteristic, 2 to 3 m broad bush belt is formed by *Salix alba,* somewhat replacing with its presence the willow bushes of the meadow at Rakamaz.

3) The forest belt is a 10 to 12 m broad forest, with an Austrian oak row at its skirts. Its growing stand is *Populus robusta.*

4) It has no swamp. This is partly replaced here by a willow plantation, created for growing willow-twigs, used for wicker-work, planted with 1 m foot and row spaces. It is yearly pruned about 50—60 cm high from the ground. The resected head formed in this way, as well as the mass of thick shoots, mean a biotope suitable for nesting. Its area is about 22 ha. Its maximum water covering is 60 cm, which gradually decreases till being dried.

5) A meadow with puddles, at its deeper points with a *Carex vulpina, C. distans, C. elata, Eleocharis palustris, Juncus inflexus, Glycerina maxima,* and *Schoenoplectus lacustris* vegetation. In its higher parts — in case of an entirely shallow water — there are: *Agrostis stolonifera, Symphytum officinale, Rumex conglomeratus.* This biotope developed in temporarily water-covered areas.

6) A dry meadow — at the highest points of the flood plain. A part of it is mown, another part is grazed. (Cf. Fig. 4). Its vegetation is the characteristic, and above mentioned, *Lythro-Alopecuretum pratensis* association.

7) The mortlake is an area of no importance, with much broader reed skirts, without any floating veagtation.

Methods of the investigation

The methods are determined by the aim: to get from the area a material as much useful as possible. For this purpose I already began informative surveyings in 1977 and 1978. With the help of these I demarkated the two areas, which were systematically investigated in 1979. In the course of this, I endeavoured to establish possibly every nesting species and pair in both meadows. I ranged, therefore, systematically over the area from early Spring till Autumn, in the course of which I have recorded the observed species, their activity and number. The data were fixed in each biotope — e.g., grass-land, grazing land, meadow with willow bushes, row of trees, swamp, etc. — separately, in order to get a picture, by means of this, of the structure of the bird colony.

For establishing the hatching species, I have taken into consideration the observed nests, the parents leading nestlings, the singing males and every circumstance that referred to hatching: egg-shell, behaviour showing an axiety for the nest, etc. During the surveys, I have recorded the data, as well, in connection with species that only arrived here for nutrition. This was primarily important in Autumn and Spring, on the occasion of migration.

Results of the investigation

In the course of the observations I have established that in respect of the number of nesting species, there is no considerable difference. (Cf. Tables 1 and 2). In the composition of species, however, there is a more considerable difference, caused by the different naturalfundamentals of the two areas. As mentioned above, in the flood-

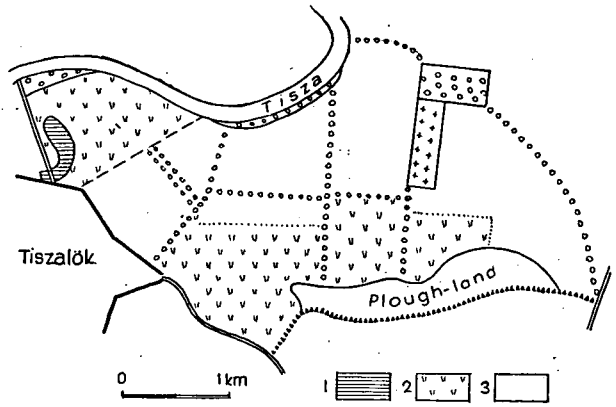

Fig. 4. Human impacts on the flood-plain meadow at Tiszalök
Key to the signs used: 1 Fishing, angling 2 Grazing 3 Mowing.

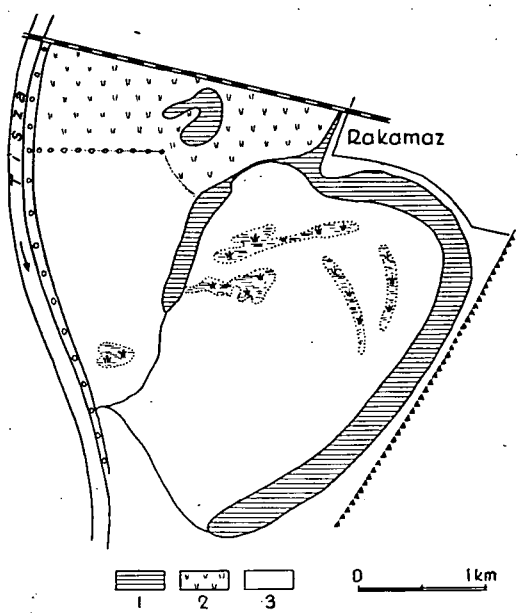

Fig. 5. Human impacts on the flood-plain meadow at Rakamaz
Key to the signs used: 1 Fishing, angling 2 Grazing 3 Mowing.

plain meadow at Tiszalök, the role of forest belts and rows of trees is more considerable, in a result of which the number of species that prefer this has increased. This is proved by the numbers, as well, which give the distribution of the bird colonies of the two areas, on the basis of nesting levels:

	Tiszalök per cent	Rakamaz per cent
Hydrocolous	3 species, 10.7	3 species, 9.3
Phragmitidicolous	7 species, 25.—	9 species, 28.1
Terricolous	7 species, 25.—	16 species, 50.—
Fructicolous	3 species, 10.7	1 species, 3.3
Dendricolous	3 species, 10.7	— species,
Arboricolous	5 species, 17.9	3 species, 9.3

Table 1. *Number of species and pairs, nesting in the flood-plain meadow at Rakamaz in 1979*

Species	1	2	3	4	5	6	7	Total
1 Ardea purpurea 1		2						2
Number of nesting species	4	16	5	5	8	5	2	32
Number of nesting pairs	11	219	13	60	52	32	2	389

Meaning of numbers in the head-piece: 1 = mortlake, 2 = swamp, 3 = grazing land, 4 = meadow with willow bushes and puddles, 5 = dry meadow with willow bushes, 6 = bleak grass-land with puddles, 7 = row of trees.

In both areas, the backbone of the colony is formed by hydrocolous, phragmitidicolous and terricolous species — what corresponds to the possibilities of the flood-plain meadow. — In case of the meadow at Tiszalök, the value of the fructicicolous, dendricolous and arboricolous species is 39.3 per cent, while at Rakamaz this value is not more than 12.6 per cent.

The value of species identity — with 17 common species — is 37.8 per cent. This is showing the doubtless and close relationship of the areas. But just the former data show the transformation, resp. the direction of it, induced by the human impact.

In the course of surveying, it could be established that in the meadow — as within an ecosystem — the species are separated in biotopes. The swamps, meadows with willow bushes, grazing lands, rows of trees, etc. (cf. Tables 1 and 2) may be characterized with definite nesting part-colonies. The nesting biotopes, to be found within the single meadows, can be parallelled. They satisfy identical or similar demands. Their bird colonies are, therefore, also identical or similar to each other. This is shown by the following:

Table 2. *Number of species and pairs, nesting in the flood-plain medow at Tiszalök in 1979*

Species	1	2	3	4	5	6	Total
1 Podiceps ruficollis Pall.					2		2
Number of nesting species	5	5	7	5	6	3	28
Number of nesting pairs	12	16	13	60	33	27	161

Meaning of numbers in the head-piece: 1 = row of trees, 2 = row of bushes, 3 = forest belt, 4 = willow plantation, 5 = meadow with puddles, 6 = dry meadow.

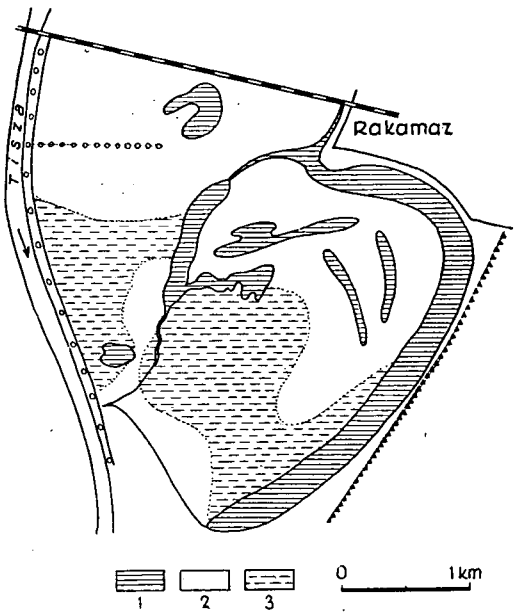

Fig. 6. The exent of water-cover in the flood-plain meadow at Rakamaz
Key to the signs used: 1 Standing water 2 Water-covered only in flood 3 Temporary, in late Summer dried.

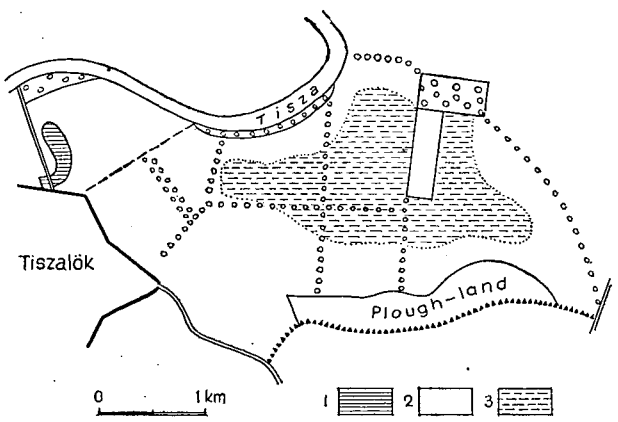

Fig. 7. The extent of water-cover in the flood-plain meadow at Tiszalök
Key to the signs used: 1 Standing water 2 Water-covered only in flood 3 Temporary, in late Summer dried.

Rakamaz:	Tiszalök:
Row of trees	Row of trees
Swamp	Willow plantation
Grazing land	Grazing land
Meadow with willow bushes and pudles	Meadow with puddles, a row of bushes
Bleak grass-land with puddles	Meadow with puddles
Dry meadow with willow bushes	Dry grazing-meadow
	Forest belt

The observed difference between the bird colonies of the two areas can also be perceived at parallelling the nesting biotopes. The forest belt of the meadow at Tiszalök has, namely, no corresponding pair at Rakamaz. Therefore here appear the forest species, the existence of which in a meadow can only be explained in this way.

The species composition of the nesting stock of the single part-areas is permanent. This is caused by the firm demands of species towards their environment. A species or colony is namely only inclined to settle in an other biotope if it can fulfil similar damands. This can be observed in case of reed warblers, which can mainly be observed at Rakamaz in the swamp, at Tiszalök in the willow plantation. A role, like this, is played at Tiszalök by the row of bushes, as well, which enables the settlement of the birds of the meadow with willow bushes at Rakamaz, to some extent.

In the interest of the further evaluation and comparison of the areas, I have calculated, how many nesting pairs can be found in a 25 ha area. I have chosen just this areal extent because I wanted to make a comparison with the data obtained from a flood-plain meadow at the Upper Tisza (LEGÁNY 1974). On this basis, I have obtained the following data:

At the Upper Tisza, in a	25 ha area, 5.3 pairs nested
At Rakamaz	25 ha area, 6.2 pairs nested
At Tiszalök	25 ha area, 4.1 pairs nested

Here I note that, at calculating the value at Rakamaz, I have not taken into consideration the gull colony, which — with its 166 nesting pairs — would have increased and deformed the value. Accordingly, it turns out of the investigation into the values referred to the areal unit (25 ha) that the meadow at Rakamaz is a comparatively richer area, which is better than the average and more valuable from biological point of view. The same cannot be said of Tiszalök.

I have investigated into the distribution of species, according to the consumed food. At ranging into the single categories, I have decided on the basis of the feeding stuffs, making the most part of nourishment. The obtained results are projected in both areas to the nesting biotopes. This was important because most species — with the exception of carnivores and a few mixed eaters — take their food in the nesting biotopes (cf. Table 3).

It is to be established on this basis that the backbone of the part-colonies of each nesting biotope is formed by insectivores, apart from which, an important role is played by the mixed eaters, as well. The carnivores — being super-predatory birds — cannot nest in every biotope, owing to their long action-radius. At the same time, they visit almost the whole meadow, in order to take nourishment.

Table 3. *Distribution of the nesting species of the flood-plain meadows, on the basis of the consumed nourishment, in the single nesting biotopes*

Rakamaz				
Mortlake			I/2	M/2
Swamp	C/3	H/5	I/6	M/2
Grazing land			I/4	M/1
Meadow with willow bushes and puddles			I/5	
Dry meadow with willow bushes		H/2	I/4	M/2
Grass-land with puddles		H/1	I/3	M/1
Row of trees	C/1			M/1
Tiszalök:				
Row of trees	C/1		I/2	M/2
Row of bushes			I/5	
Forest belt		H/1	I/5	M/1
Willow plantation	C/1	H/1	I/3	
Meadow with puddles		H/3	I/2	M/1
Dry meadow			I/1	M/2

Sign legends: C = carnivore, H = herbivore, I = insectivore, M = mixed eater. The numbers behind the letters designate the number of nesting species.

On the basis of observations, the meadow proved to be an ecological unit, where the production of feeding stuffs is larger than the consumption. I have not observed any influx of matter — feeding stuff — only the export of that. That is to say, I have observed in several cases some species that took nourishment in the meadow but did not nest there. In order to show the degree of this, I am publishing here the data of a single day of observation — 21 May, 1979 — from the meadow at Tiszalök:

1	*Ardea cinerea* L.	4 individuals
2	*Ardeola ralloides* SCOP.	4 individuals
3	*Egretta garzetta* L.	5 individuals
4	*Nycticorax nycticorax* L.	30 individuals
5	*Ciconia ciconia* L.	25 individuals
6	*Ciconia nigra* L.	1 individuals
7	*Anas platyrhynchos* L.	80 individuals
8	*Anas querquedula* L.	30 individuals
9	*Aythya ferina* L.	50 individuals
10	*Aythya nyroca* GÜLD.	30 individuals
11	*Philomachus pugnax* L.	150 individuals

Note: The above species all were observed in the meadow with puddles.

The number of the individuals, which only took food there, mainly increased in the time of the spring migration. It is, namely, in that time that the spring flood recedes to the riverbed, filling with water every small dip. This gives an excellent eating and resting place to the various Anatidae and *Limicola* species. The dicisive role of water is also proved by, that on the occasion of autumn migration the number of bird masses is much lower, and even it may be entirely missing, because there is no water in the area. Then, a movement of birds may only be observed in the deeper laying areas of the meadow at Rakamaz with standing water.

It is obvious even from the above described facts that the meadow at Rakamaz is a more valuable area from any points of view. The cause of this can be explained by various human impacts. There are among these primarily: grazing, mowing, and river control. During my observations, I attempted to investigate into the effects of these upon the living world.

Grazing — owing to its known effects — degrades the meadow. This may be registered not only in the vegetation but, as a result of this, in the bird colony, as well. The grazed lands have, namely, always a lower species number than the similar, but not grazed, sections. For instance, I have observed at Rakamaz five and at Tiszalök only three hatching species. And even the same species occurs here with a lower individual number than in control areas.

For instance, at Rakamaz, in the grazing land, three pairs of *Vanellus vanellus* L. nested, while in the bleak grass-land with puddles 15, and in the meadow with willow bushes and puddles 10 pairs.

Not more than one pair of *Limosa limosa* L. hatched in the grazing land, on the other hand, 10 pairs did this in the bleak grass-land with puddles, and 6 pairs in the meadow with willow bushes and puddles.

It is to be noted, at any rate, that we must not draw of this conclusions of general value because this is valuable only here. At the same time, there are some species that hatch or mostly hatch in grazing lands and their number is not influenced at all by grazing — e.g., *Alauda arvensis* L.

As mowing takes place, luckily, after the first hatching, its effect does not seem to be as harmful as it could be otherwise. But it cannot be called advantageous, either, because I have established in the course of surveyings that in the mown areas I have not observed any bird, at all, where before — in case of a high grass — they were in large numbers. This was my concrete observation in the meadow at Tiszalök on 11 June, 1979. And I had similar observations at Rakamaz, as well.

As to river control, it was of the most obvious effect upon the avifauna of meadows. As long as the meadow at Rakamaz preserved its original surface — we find in it hardly any channel — as a result of this, the draining of the area follows much later every year. To say nothing of that some continuously water-covered deeper places always remain in this area. On the other hand, in the meadow at Tiszalök — with the aim of an intensive meadow and grazing-land economy — a network of canals was formed for drainage and possibly for irrigation. As a result of this, the area is dry at the end of May or the beginning of June and the hygrophilous species disappear.

At last, I mention afforestation from among human effects. This has induced, besides the economy of water supplies, the most important change. This manifests itself in the composition of species and has caused the difference between the two areas (cf. Figs. 4 and 5).

By reason of all these, we may draw the following conclusions:

1) As a result of the human environment-forming activity, the original, autochthonous bird colony is reduced to poverty, changes, in respect both of its species and individual numbers.

2) As a result of afforestation, in the meadow a settling down of species followed that was foreign from the ecosystem there.

3) It is still possible to find in the flood plain of the Tisza some ecosystems that have preserved comparatively much of their original feature and living world. For instance, the flood plain at Rakamaz.

4) The areas, where the premaeval state can still be found, even if with more or less changes, ought to be placed under protection. It is justified, therefore, to declare the flood-plain meadow at Rakamaz protected, connected with the Tokaj Region Conservation District, to be created in the future.

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A tiszalöki és rakamazi ártéri rét összehasonlító ornithológiai vizsgálata

LEGÁNY A.

Kivonat

A dolgozat a rakamazi és tiszalöki ártéri rétek madárvilágának összehasonlító elemzését végezte el. Szerző a rendszeres állományfelvételezések során megállapította, hogy milyen összefüggések adódnak a fészkelő madárfajok és párok számát illetően, valamint a környezetökológiai változások minőségét illetően. Eszerint:

1) A fokozódó anthropogén hatásra a vizsgált területen is bizonyos mérvű degradálódás mutatható ki.
2) A rétek és legelők befásítása következtében idegen madárfajok, főleg arborikol és dendrikol elemek telepedtek meg.
3) A Tisza fent nevezett árterületein azonban az eredeti flora- sé faunaelemeket napjainkig megőrző szakaszok.
4) Mivel a Tisza eredeti élővilágának megőrzésére volna itt lehetőség, szerző kívánatosnak tartja rakamazi rét természetvédelmi területté nyílvánitását.

СРАВНИТЕЛЬНОЕ ОРНИТОЛОГИЧЕСКОЕ ИССЛЕДОВАНИЕ ПОЙМЕННЫХ ЛУГОВ В РАЙОНЕ ТИСАЛЁК И РАКАМАЗ

А. Легань

Резюме

Автор провёл сравнительный анализ мира птиц пойменных лугов в районе Тисалёк и Ракамаз. В ходе систематического подсчёта численности птиц автором установлены определённые зависимости относительно видов гнездящихся птиц и числа пар, а также качественных экологических изменений среды. В соответствии с этим:

1) Усиливающееся антропогенное влияние и на исследуемой территории вызывает определённую деградацию.
2) В силу насаждения деревьев на лугах и пастбищах поселились новые виды птиц, главным образом арборикольные и дендрикольные элементы.
3) Вышеуказанные пойменные участки представляют собой такие территории, которые до настоящих дней сохранили первоначальную флору и фауну.
4) Поскольку здесь возможно сохранение первоначального живого мира, автор считает желательным объявить луг в Ракамази заповедной территорией.

Uporedna ornitološka instraživanja plavnih ritova na području Tiszalök i Rakamaz

Legány A.

Abstrakt

U radu je izvršena uporedna analiza ornitofaune plavnih ritova na području Tiszalök i Rakamaz. Autor je na osnovu redovnih snimanja utvrdio uslovljenost medju gnezdaricama kao i njihovih parova u zavisnosti od kvalitativnih ekoloških promena sredine, i to:

1) Pod povećanim antropogenim uticajem i na ispitivanim područjima se javljaju odredjene degradacije.
2) Usled pošumljavanja ritova i pašnjaka javljaju se strani predstavnici ornitofaune, pre svega arborikolni i dendrikolni elementi.
3) Navedena plavna područja Tise su svakako deonice koje su do današnjih dana sačuvali autohtone florističke i faunističke elemente.
4) S obzirom da na ovom području postoji mogućnost za očuvanje autohtone faune autor smatra poželjnim proglašenje rakamazinog rita zaštićenim područjem.

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INVESTIGATION INTO THE NEST COLONIES AND NESTING BEHAVIOUR OF THE STARLING (STURNUS VULGARIS L.) IN THE FLOOD PLAIN OF THE TISZA

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Abstract

The nest colonies of the starling play an important role in the living-space of the birds nesting in the flood plain of the Tisza. The colonies are formed in the sections, rich in hollows, of the willow plantation in the flood plain, after the arrival of starlings at the end of March. The birds, which nest in the forest but fly out to the neighbouring culture area, as well, could be followed with attention and counted from the dike, from which the number of nesting pairs could be concluded. Starlings bring at the same time more than one insect to their nestlings, their rhythm of feeding is fast, thus they destroy a large amount of insects. Their customs, conduct forms during the nesting time contain particular elements, as well, which cannot be observed in other singing-bird species.

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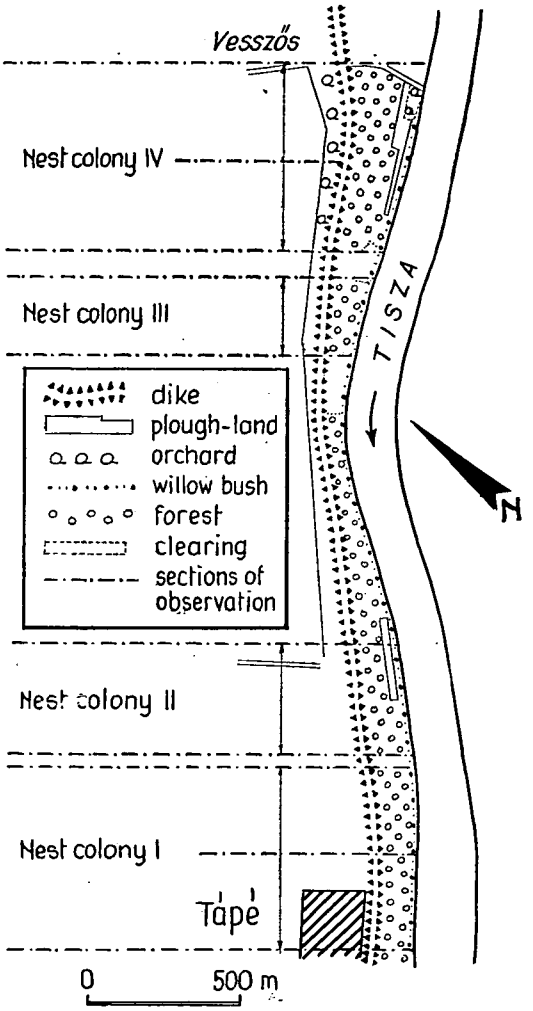
The situation and role of the nesting colonies of the starling in the flood plain of rivers is not cleared. In the flood plain of the Tisza it has not been investigated, as yet. I have therefore decided to take this question, which is important from scientific and economic points of view, under examination.

I have observed the starling not-systematically since 1958, systematically since September 1977. The main area of observation was the sector at Tápé—Vesszős, at the right bank of the Tisza, in the neighbourhood of Szeged (Fig. 1), besides which the hobby-gardens at Szeged, Makra-szék (Szatymaz) and Tőserdő (flood-plain of the Tisza Dead-Arm) were control areas.

Seven km north-east of Szeged, a 3400 m long, 20 to 250 m broad section of the flood plain at the right bank of the Tisza, is covered with a characteristic willow-poplar gallery forest (*Salicetum albae fragilis*). (Fig. 1). Here I carried out in Summer 1978 a quantitative stock-survey, from the arrival of the first starling pair (27 March) till the taking flight of the nestlings from the first hatching (1 July).

The starling pairs gradually occupied the sections of the gallery forest that were suitable for nesting, abounding in natural hatching hollows. The selection of hollows and then pairing began (6 April). After laying the first eggs (15 April), the formed nest colonies could already be estimated with good chance. The result of the estimation performed on 21 April agrees well with the data, established more exactly later, in the time of feeding. On 21 April, I observed a strong movement of starlings. The birds moved between the forest and the agricultural area, a number of males sang on the top or crown of willows.

At the end of April the Tisza inundated the flood plain, thus I chose a farther nest, for observing the bird behaviour during feeding. In Makra-szék (Szatymaz) four starling pairs nested in tree-hóllows, cut by woodpeckers in an abandoned farmyard. On 19 May, the birds fed some 10—12 days old nestlings.



One of the pairs gave food to nestlings eleven times in 30 minutes. Averagely, 2.5 to 3 minutes pass between two feedings. The extreme values were: the shortest time 10 seconds, the longest time six minutes. The birds flew for nourishment to the nearby meadow of wet grass or to the farther agricultural area.

In the flood plain between Szeged—Tápé and Vesszős, I undertook a quantitative stock-survey in feeding time. My aim was to establish the number of nesting pairs,

the extent of nest colonies. I carried out observation with the following method: As the starlings moved between their nesting places in the forest and the culture areas beyond the dike, I stood on the top of the dike and counted, in a definite section, for ten minutes, the birds flying into the forest, with some food in their bills. As a control, I also counted the birds, flying out of the forest. I have divided the obtained number with the 2.5—3 minutes feeding time, established beforehand. In this way, I have got the number of nesting pairs. I have completed this method by observing that the feeding pairs mostly fly by the same air-line towards their nest in the forest. Thus, recording and counting these directions, I have always got results that were similar to the previous counting. The forest sections were always chosen so that they had well-observable boundaries (e.g., forest clearance, dike passage leading down, high-voltage line). It was easy to count the feeding starlings between these boundaries (Table 1).

Table 1. *Number of nesting and feeding starlings*

	Designation of the nest colony	Length of the observed forest section in m	Number of indiv. flying in	Number of indiv. flying out	No. of nesting pairs	Total number of nesting pairs		
						V.20	V.25	V.31
I	The first section of nest colony I	400	25	28	10	15	12	4
	The second section of nest colony I	400	16	9	5			
II	Nest colony II	400	16	17	6	6	5	2
III	Nest colony III	350	17	16	5	5	5	0
IV	The first section of nest colony IV	300	107	80	35	53	25	2
	The second section of nest colony IV	300	51	57	18			

Note: The duration of observations was 10 minutes.

In the rather long forest section between nest colonies II and III no starling nested, probably owing to the considerable narrows of the forest and for lack of natural hollows (Fig. 1). At the re-enlarging of the forest, a pair nest separately.

According to my observations, the food-taking districts of starlings are the following, in a sequence of frequency: 1) the slopes of dike, 2) the air-space above the agricultural areas, 3) the top of dike and the gallery forest, 4) the orchard, the trees and underwood of the forest belt, 5) the grassy parts of the agricultural areas, 6) farther gardens, plough-lands.

Most starlings collect food for their nestlings in the grass on the slopes of dikes. They rarely fly farther. In the agricultural area, in the nesting period, the corn is 0.5 m high. Here the starlings do not alight but catch flying, like fly-catchers, the insects swarming above this area. They do this often, even if flying towards their nests for feeding, their bills are full of insects. They almost always bring more than one insect simultaneously. Their manner of gathering food also tends to catch as many insects as possible: they pick up insects, hopping about fast in the grass. Sometimes they

jump up repeatedly into the air after the insects flying up. They often together gather the easily observable insects climbing over the top of the dike.

The most starlings are in nest colony IV: 53 pairs in a 600 m forest section. Here, at the slope of the dike, only few birds gather their food. (The number of insects is probably strongly rarified). On the other hand, a lot of individuals hunt flying or bring the food from farther slopes of dikes. Once a starling brought a smaller lizard in its bill for feeding.

One bird brings on average two insects in its bill. During the daily feeding time of 14 hours, it brings 616 insects to its nestlings, the 80 pairs bring daily 98,560 insects, and during the 21 day long period of breeding the nestlings: 2,069.760 insects.

Between nest colonies II and III, at the side of the dike, a pack of starlings, consisting of 14 individuals, holding strikingly together, took nourishment for a long time. As none of them flew up to feed nestlings, they must have been, as I suppose, males unable to proliferate, which, in the time of hatching, avoid the feeding district of the nest colony, thus they don't eat the food given by the area from the hatching pairs and their nestlings (LORENZ 1931). I also saw a pack like this, of 30 individuals, close to nest colony IV, in the underwood of an orchard, in the grass. I observed these later, too, on 25 May, in the same place.

The following stock-survey took place on 25 May (Table 1). The differences (nest colony I : 3 pairs; nest colony II: 1 pair; nest colony IV: 24 pairs) arise from that these pairs had their nestlings already flown out. Then I observed two flying nestling.

The starlings of nest colony IV often fly into the small gardens of the houses in Tápé and catch the insects there. Beyond the houses, there are cornfields, in that direction only a few starlings flew. They prefer, in the agricultural areas, as well, mainly fallow grounds, with low grass. At the slopes of the dike, the grass is already high, only a few birds flew down there for gathering food. But I already observed several of them in the mown places at Tápé. Now, they have not hunted at all, like fly-catchers, because, owing to the bad weather, cold wind, there was no insect swarming, either. A few starlings looked for food in the foliage of the crown of trees in the orchards, too, but they also flew to the farther thin-sown rape-sowing, as well.

The stock was at the survey on 31 May: in nest colony I 4 pairs, in nest colony II 2 pairs, in colony III none, in colony IV not more than 2 pairs feeding (Table 1). The sound of young birds flying out of the forest or being just before flying can be heard. I have seen in the grass at the slope of the dike a pack consisting of five young and three old birds, as well. Sometimes one or two young starlings, just learning flying, describe a short circle at the fringe of the forest, in the company of the parents. Then, in a day free from wind, the old birds hunt in the manner of fly-catchers, too. One of them brought even two mole crickets *(Gryllotalpa gryllotalpa)* to its nestlings. The nestlings of the birds of nest colonies III and IV flew out earlier. It is to be noted that I have observed the first arriving pairs in this forest section; and nest-building, too, began here a few days earlier than in nest colonies I and II. Now, more than one individual even sing: they are about to hatch for the second time.

In case of the first control nest (Újszeged), the male sings, the second hatching began here, as well.

In case of the second control nest (Szatymaz, Makraszék), on 2 June: two nestful birds, which flew out, sit in the leafy crown of one of the poplars. The old birds fly into the grass, 15 to 40 m far, and feed their nestlings with insects brought from there, often, in every two — three minutes. I have observed twice that the parents, flying

down into the grass, were sometimes followed by a young but these soon returned on the tree (instinct of following the parent, LORENZ 1931).

In the same place, there were some nestlings in the hollow of a willow-tree, just before flying out. The parents first fed them twice, then tried to swindle them out of the hollow: in quick succession, they held on several times to the opening of the hollow, then they sang, hopping on the neighbouring branches of the tree, giving bird-calls. I have observed two times that one of the birds flew to the opening with a green leaf, detached from an elder-bush, standing before the nest, and put it into the hollow. Later on, returning to a branch, it shook the leaf out of its bill. Once they did the same with a blade of grass, too. During this time (for two hours!) they did not feed their nestlings at all. Thus, they probably tried to induce them by starving to leave the hollow. During the scene, two other starlings "assisted" at the event but only in so far as they repeatedly returned, hopped on the branches around the hollow and sang.

They similarly swindle the nestlings out of the hollow on 3 June, in the same way as on the former day. From the opening of the hollow a long blade of grass stands out.

On 7 June, there is no more nestling in the neighbourhood.

Besides the starling, a frequent hatching bird is here the tree-sparrow, as well. It similarly nests in hollows and flies to the dike, agricultural areas to feed and gather food to its nestlings. This does not mean, after all, any competition to the starling because it nests in hollows of much more confined opening, and the number of insects, to be found in the grassy areas, supplies enough nourishment to sparrows. It only hunts very rarely like a fly-catcher. In the observed section 35—40 pairs hatched.

In the flood plain of the Tisza, one of the most populous species is the starling. Its role is much debated even today, particularly in economic relation. The starlings, nesting in the flood plain, acquire their food mainly from the neighbouring agricultural areas. They have two hatchings a year, thus they destroy a huge quantity of insects during the feeding period. Their role may, therefore, be by all means positive.

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A seregély (Sturnus vulgaris L.) fészektelepeinek és fészkelési magatartásának vizsgálata a Tisza hullámterén

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Kivonat

A seregély fészektelepei fontos szerepet töltenek be a Tisza hullámterén fészkelő madarak életterében. A kolóniák a hullámtéri füzesek öreg fáinak odvaiban alakulnak ki a seregélyek március végi megérkezése után. Az erdőben fészkelő, de a szomszédos kultúrterületekre is kirepülő madarakat az árvédelmi gátról jól figyelemmel lehetett kísérni és megszámolni. Ezek alapján következtetések voltak levonhatók a fészkelő párok számára vonatkozóan. Megfigyelhető volt, hogy a seregélyek egyszerre több rovart is képesek csőrükben fiókáik etetéséhez fészkükbe szállítani. Etetési ritmusuk is gyors, s ezáltal nagy mennyiségű rovart képesek elpusztítani. Fészkelési idő alatti szokásaik s magatartási formáik különös elemeket is tartalmaznak, melyek más énekes madárfajoknál nem figyelhetők meg.

ИССЛЕДОВАНИЕ ГНЕЗДОВЫХ КОЛОНИЙ СКВОРЦОВ И ИХ ПОВЕДЕНИЯ ПРИ ГНЕЗДОВАНИИ В ЗОНЕ ПРИЛИВА ТИСЫ

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Резюме

Гнездовые колонии скворцов составляют значительный удельный вес в жизненном пространстве гнездящихся в зоне прилива Тисы птиц. Колонии формируются в дуплах старых ив поймы после прилёта скворцов в конце марта. Гнездящиеся в лесу, но вылетающие на соседние культурные территории птицы легко поддаются подсчёту. На основе подсчётов были сделаны выводы относительно числа гнездящихся пар. Наблюдалось, что за один прилёт скворцы способны принести птенцам в клюве нескольких насекомых. Ритм кормления быстрый, за короткое время способны уничтожить большое количество насекомых. Привычки и формы поведения в период гнездования включают и такие элементы, которые не наблюдаются у других видов поющих птиц.

Ispitivanje kolonija i ponašanja čvorka (Sturnus vulgaris L.) pri gneždjenju na plavnom području reke Tise

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Abstrakt

Medju gnezdaricama plavnog područja reke Tise kolonije čvoraka imaju značajnu ulogu. Formiranje kolonija se odvija nakon pridolaska čvoraka krajem marta, u dupljama starih stabala u vrbacima plavnog područja. Sa nasipa je bilo moguće veoma uspešno posmatranje i prebrojavanje ptica koje su se gnezdile u šumi i obletale susedna područja pod kulturama. Na osnovu toga moguće je bilo utvrditi broj parova ptica gnezdarica. Takodje je pri osmatranjima uočeno da čvorci pri ishrani mladunaca donose odjednom i više insekata. I ritam ishrane im je brz, stoga uništavaju veliki broj insekata. Za vreme gneždjenja u njihovim navikama i bolicima ponašanja javljaju se specifični elementi koje kod ostalih ptica pevačica nedostaju.

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THE FOOD BASIS OF ROOKS (CORVUS FRUGILEGUS L. 1758), WINTERING IN THE NATURE RESERVE AT MÁRTÉLY AND SASÉR

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Abstract

The paper wants to establish the mass ratio of the rooks, wintering in the two nature reserves lying in the flood plain of the Tisza Dead-Arm at Hódmezővásárhely, as well as the composition, quantity of their dominant-subdominant food and finally the energy coming from their consumed food. As a final conclusion, it demonstrates that the bulk of the winter food basis consists of the seeds of weeds and of agricultural cultivated plants, otherwise beling lost. The wintering rook mass induces, therefore, no agrarian problem. They only show some damage in case of those remaining for hatching.

Introduction

In the neighbourhood of Hódmezővásárhely, in the flood plain of the Tisza, two considerable nature reserves were created: at the right riverside Sasér of 10 ha extent, at the left riverside the ten km long extending Mártély of 2260 ha. The environment, birds, mammals, and fishes of these nature reserves, which are characteristic nature conservation areas of the Tisza flood plain, are treated in detail in my quoted papers (STERBETZ 1972, 1975). In the high forest stand *(Salicetum albae fragilis)* of both areas, at its *Populus* sp. level, many hundred thousands of rooks (*Corvus frugilegus* L. 1758 assemble from late Autumn till early Spring. A considerable part of the wintering crowd passes in Spring, only a hatching population of fluctuating number remains in Sasér, the mass ratio of which I treated in a separate paper (STERBETZ, 1977). The organic-matter mass of the daily food demand of these winter crowds can be expressed in tons. For the nature conservancy, agricultural and wild-fowl economic practice it is desirable to know the quantitative and qualitative formation of this, the action-radius, daily activity of birds, and the character of the fostering areas. I endeavoured to answer all these question in the framework of a 10-year long environmental cycle.

Materials and Methods

I began investigating in the winter of 1968/1969 and later have developed my investigation into a 10-year programme in the months November-December-January-February. I strove to assess the birds, as possible, arriving at the sleeping-place or streaming from there, counting them from the dike of the river. From the mean value of observations I calculated the average individual number, falling on 1 month, then I used the 10-year average of these, for starting-point of further calculations. In

order to express the living weight of the bird mass (biomass), I have calculated with 500 g/ind. (This value was calculated, by weighing the individuals collected for the investigation of the gastric content).

For calculating the ratio of the different food sorts, and for investigating into the gastric content, I have collected monthly ten individuals. Thus, I could evaluate altogether four hundred individuals during ten years. By reason of this, the average weight of the daily consumed food of a bird is 45 g, according to a very careful calculation, evaluating it rather low. At the evaluation, I took only into consideration the dominant-subdominant food sorts that can be expressed in percentage, as well. The other, very many-sided but only occasional food sorts, presenting themselves but in traces, have no practical importance from the point of view of outlining the food basis.

To establishing the quantity of pure energy, originating from the single food sorts, the starch value, generally used in the agricultural practice, gave the basic point of departure (starch value = the number that informs us of the full energetic effect of the single food sorts. It expresses, with how much isolated starch the 1000 g of the components of the food exert an identical nutritious effect). The starch value of the appreciable food sorts is contained in Table 1. 1 starch value is equal to 2356 calories (BAITNER 1976). In order to avoid high numbers, further on we shall calculate with megacalorie (one thousandth of this). Thus, 1000 g starch value = 2.356 megacalories.

Table 1. *Starch value of 1000 g of the evaluated food sorts*

Zea mays grains	726 g
Triticum vulgare seeds	700 g
Oryza sativa seeds	800 g
Setaria sp. seeds	572 g
Segetal weed-seeds	733 g
Micromammalia sp.	760 g
Insecta sp.	190 g

I could not hold birds in a closed place. I could, therefore, not attempt, to observe the digestive process in a laboratory. Thus, I could not evaluate the further effects of excretion and must be content with characterizing the consumed food.

I have attempted to establish the action-radius of the birds looking for a fostering area, by following by car the birds, flocking out and returning home, in the morning and in the evening. In the last year of observation, I draw a parallel between the morning flight, resp. the return to the sleeping-place and the measurable light quantity. For measuring light, I used a photometer of Lunasix-type, suitable to establish a photographic exposure time from 1/4000 sec. till 8 hours. The index-numbers of this instrument could simply be converted into lux values by means of a given Table. With this simple but very exact method, the limiting values of the beginning and end of the daily activity were expressed in lux.

Results

It turns out of the data of Table 2 that the number of wintering rooks continuously increases in the forests of the flood plains of the Tisza from November. In January it reaches its culmination but in February quickly decreases, as a result

Table 2. *Formation of mass-ratios (average individual number)*

Year	XI	XII	I	II
1968/1969	30.000	140.000	150,000	20.000
1969/1970	30.000	150.000	170.000	10.000
1970/1971	40.000	150.000	160,000	10.000
1971/1972	20.000	120.000	140.000	5.000
1972/1973	40.000	140.000	200.000	5.000
1973/1974	40.000	160.000	250.000	6.000
1974/1975	40.000	150.000	230.000	5.000
1975/1976	50.000	140.000	200.000	7.000
1976/1977	30.000	120.000	160.000	6.000
1977/1978	20.000	90.000	100.000	6.000
Average:	34.000	136.000	176.000	8.000

Table 3. *Formation of the biomass of rooks*

	Ind.	kg
XI	34.000	17.000
XII	136.000	68.000
I	176.000	88.000
II	8.000	4.000

Table 4. *Formation of the daily food*

Food	XI		XII		I		II	
	p.c.	kg	p.c.	kg	p.c.	kg	p.c.	kg
Zea mays grain	62	948	60	3.672	60	4.752	50	180
Oryza sativa seed	10	153	22	1.346	20	1.584	30	108
Triticum sp. seed	6	93	6	367	10	792	5	18
Setaria sp. seed	15	229	10	613	7	554	12	43
„Ruderalia" seed	3	46	—	—	2	158	2	8
Mammalia sp.	3	46	2	122	1	80	1	3
Insecta sp.	1	15	—	—	—	—	—	—
Total:	100	1.530	100	6,120	100	7.920	100	360

Table 5. *Daily food, expresses in starch value*

Food	XI	XII	I	II
	kg	kg	kg	kg
Zea mays grain	692	2.680	3.469	131
Oryza sativa seed	126	1,103	1.299	89
Triticum sp. seed	65	256	554	13
Setaria sp. seed	130	349	316	24
„Ruderalia" seed	33	—	115	5
Mammalia	35	93	61	2
Insecta	3	—	—	—
Total:	1.084	4.481	5.814	264

of removing the nesting place. In Table 3, the biomass of the average quantities is shown. Table 4 records the daily food-needs of rooks. The same can be seen in Table 5, expressed in starch value. In Table 6, the megacalorie-amount is given, calculated from starch values.

The action-radius of rooks is between 5 and 60 km. The upper limit may be much

Table 6. *Quantity of the obtained megacalorie*

	Megacalorie/day	Megacalorie/month
XI	2.554	6.620
XII	10.557	327.267
I	13.697	424.607
II	622	17.416
Total:		845.910

more extended but I could not follow longer than this the packs that ascertainably flew from sleeping places at the Tisza. Over forty km, the observation always took place in a snowy weather.

The character of the area of nourishment is always determined by the demonsrated food sorts. The weed-seeds, demonstrated in high number, originate from rice-fields in a considerable percentage. The various small mammals may originate first of all from lucerne fields and grassy steppes.

On the basis of the mean values of photometry, the morning swarming of rooks begins at 44 lux-values. They reach the far away feeding areas between 88 and 350 lux. The evening return already begins at about 700 lux value and the last packs reach their sleeping-place between 44 and 22 lux.

Conclusion

It is proved by the thought-provoking high numbers that the crowds of rooks, wintering in the investigated sleeping-places demand a huge quantity of food. It is striking, how low the ratio of animal food sorts is in addition to the values of the seeds of dominant and subdominant cultivated plants and the comparatively also considerable weed-seed values. This may certainly be explained with the considerable agrochemicalization. Because of the maize combines, working with a high loss of grain, the Zea mays grains, remaining in the stubble fields, prevail as dominant food during the whole winter. The Oryza and Setaria values of the rice-fields in the neighbourhood of the nature reserve form the subdominant food. The seeds of Triticum, which takes place among the cultivated plants, cannot be qualified as an induced damage, either, because in such a late period it can only originate from the neighbourhood of stacks, farm-buildings. That is to say, every planted seed would perish without the intervention of birds, as well. The large rook concentration only becomes dangerous in the vicinity of nesting places from Spring, when the feeding birds damage the cultivated plants and the progeny of the protected or huntable animals.

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A mártélyi és saséri természetvédelmi területeken telelő vetési varjak (Corvus frugilegus L.) táplálékbázisa

STERBETZ I.
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Kivonat

A tanulmány a Tisza hullámterében levő két hódmezővásárhelyi természetvédelmi területen telelő vetési varjak tömegviszonyait és dominans-subdominans táplálékuk összetételét, mennyiségét végül az elfogyasztott táplálékból származó energiát kívánja megállapítani. Végkövetkeztetésként kimutatja, hogy a téli táplálékbázis zöme egyébként veszendőbe menő mezőgazdasági kultúrnövények magvaiból és gyommagvakból áll. Ezért a telelő varjútömeg nem okoz agrárproblémákat. Kártételük csak a költés céljából visszamaradók esetében mutatkozik.

ОСНОВА КОРМА ГРАЧЕЙ CORVUS FRUGILEUS L. ЗИМУЮЩИХ В ЗАПОВЕДНИКАХ МАРТЕЙ И ШАШЕР

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Резюме

Работа имеет целью установление количества и состава доминантно-субдоминантного корма зимующих на территории двух заповедников г. Ходмезёвашархей (в пойме р. Тисы), а также количество получаемой с кормом энергии. В качестве конечного вывода указывается, что основной зимний корм грачей состоит в основном из теряемого при посеве зерна культурных растений и зерна сорняков, а потому зимняя масса грачей не причиняет аграрного ущерба. Ущебр наблюдается лишь от остающихся для вывода птенцов грачей.

Ishrana gačaca (Corvus frugilegus L.) na zaštićenom području Mártély i Sasér

STERBETZ I.
Ornitološki institut Budapest

Abstrakt

U radu se prikazuju jata gačaca koja zimuju na dva zaštićena područja na deonicama plavnog regiona Tise u okolini Hódmezővásárhely-a. Prikazuje se sastav i količina dominantne i subdominantne hrane, kao i energetska vrednost korišćene hrane. Utvrdjeno je da osnovu zimske ishrane čine semena kulturnih i korovskih biljaka koje su i inače kao rasute neiskorišćene. S toga jata gačaca na zimovanju ne prouzrokuju štete u poljoprivredi. štetu pričinjavaju samo one ptice koje ostaju radi gneždjenja.

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SPECTROGRAM ANALYSIS OF THE NIGHT HERON (NYCTICORAX NYCTICORAY L.) CALLS AT THE HERONRY OF LABODÁR

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(Received 10 September, 1979)

Abstract

The calls of the night herons in the heronry of Labodár was followed by tape recording and subsequent spectrogram analysis from pair forming till end of the nestling period. Several breeding and nestling calls were recorded. Breeding calls were registered from the second half of April 1978 reaching their maximum immediately before the start of nesting and then stopping abruptly. A second smaller maximum was observed later emitted by those birds who failed with nesting owing probably to egg robberies.

Nestling voices were audible from the second half of May and they got more and more intensive week by week. In the second fortnight of June the young birds left their nests and were standing around on the nearby branches of willows.

Intruduction

The social and sexual behaviour of the night heron and black-crowned night heron (*Nycticorax* n. *hoactli*) were investigated in details by LORENZ (1938), ALLEN and MANGELS (1940), NOBLE and coworkers (1938, 1942) and STEINFATT (1943). Different hoarse, greeting voices are described at the breeding places as quark-quark, quok-quok frequently followed by a guttural cawing "wa-wa-wa-wa-wa" and tenderness under mutual preening. The nesting period consists of 21 days (NIETHAMMER 1966).

The heronry of LABODÁR is on a territory of the Tisza flood-plain between the borders of the villages Csanytelek and Felgyő. LABODÁR streches from the 226 till the 227 river km. on the right flood-plain side of the Tisza river. Its vegetation consists of willow and poplar gallery forests *(Salicetum albae fragilis)*, (Fig. 1 and 2).

The heronry is located on the southern part of the LABODÁR channel of the Tisza. It originates from 1963 when the previous colony northwards was distructed owing to woodcutting. The LABODÁR territory is since 1976 under strict protection of the Council of National Nature Protection (BOD and MOLNÁR 1979).

Methods of investigation

Night heron calls were recorded at the heronry from April till July 78 and 79 continously once weekly during several hours. A Grundig C 200 automatic tape recorder was used at 19 cm/min speed with a cardioide dynamic microphone cable transformator Type MKT—1H, AEG.

A Sound Spectrograph Series 700 model (voice identification Inc.) was used to prepare spectrograms with a frequency response of 85—8000 Hz as described previously (Wollemann and Olaszy 1977). One spectrogram displayed 2.4 sec of sound.

Results

The nesting stock of the willow trees consisted in 1978 of 61 pairs of night herons and 7 pairs of little egrets, in 1979 68 pairs of night herons and 14 pairs of little egrets were observed. Behind the canal on the poplars further night heron (56) and grey heron (37) nests were situated but their voices were not recorded owing to approaching difficulties and the height of the nests. These trees were occupied first by the grey herons who arrived already in the first half of March (11) whereas night herons were observed only on March 31 and little egrets on April 15, 1979. First breeding calls of night herons were observed on April 22, 1978 resp. April 15, 1979. (Fig. 3, 4, 5, 6) The frequency/min of the breeding calls increased gradually and reached the maximum on April 29, 1978 (3/min) resp. May 5 1979 4/min in average counting for one hour. Thereafter an abrupt stopping of the breeding call occured reaching somewhat later a second minor maximum on June 4. 1978 1 call/min. resp. May 20, 1979. This could be attributed to those birds who failed with nesting since numerous empty eggshells were found on May 13, 1979 on the dam owing to the nest robberies of hooded crows (Corvus corone cornix).

Nestling voices were barely audible from May 13, 1978 and subsequently recorded from May 28, 10 and 17, 1978. (Fig. 7, 8, 9, 10). As it turned out few high pitched

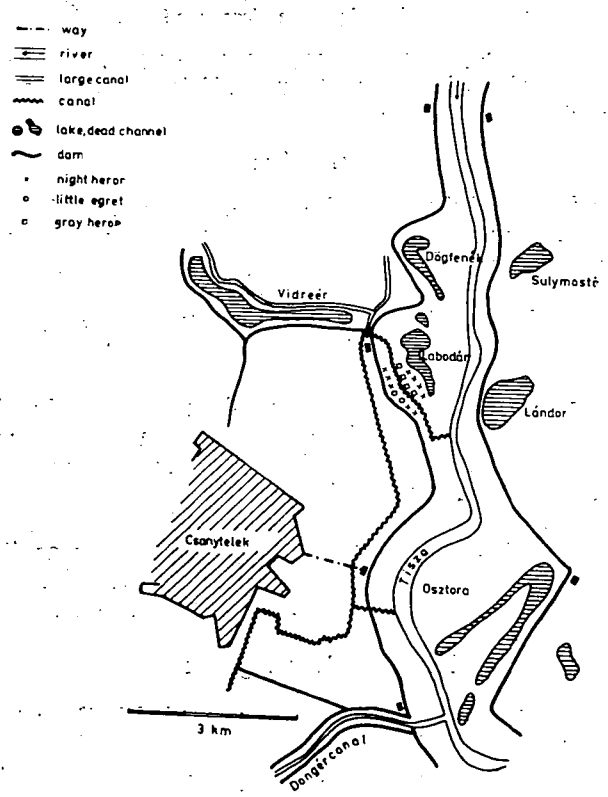


Fig. 1. The heronry of Labodár and its surroundings.

Fig. 2. The main nesting places of Labodár as seen from the dam.

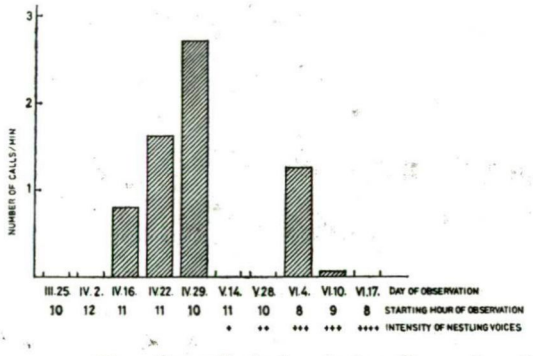


Fig. 3. Frequency of breeding calls during the breeding and nesting period. Occurence of nestling voices.

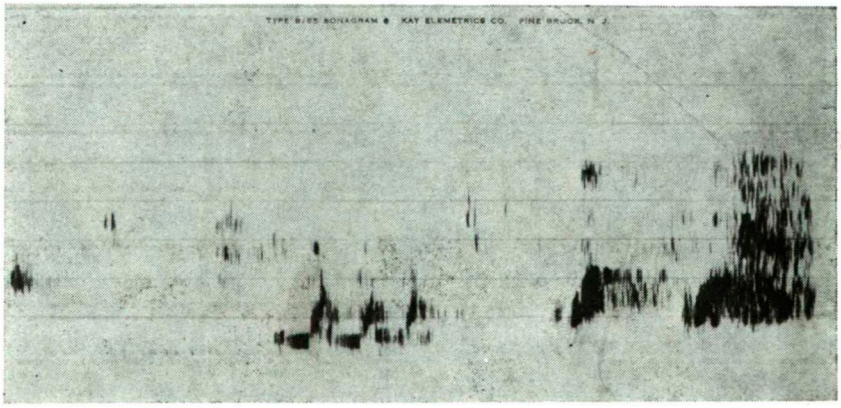


Fig. 4. Spectrogram of breeding call "wawawa" repeated twice. The timing gradation on the abscissa is 0.1 sec and on the ordinate 1000 Herz.

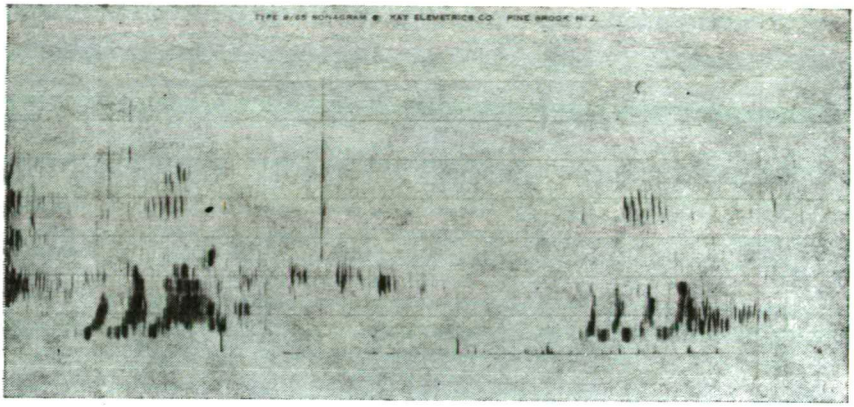


Fig. 5. Spectrogram of breeding call "wawawa" and "quock".

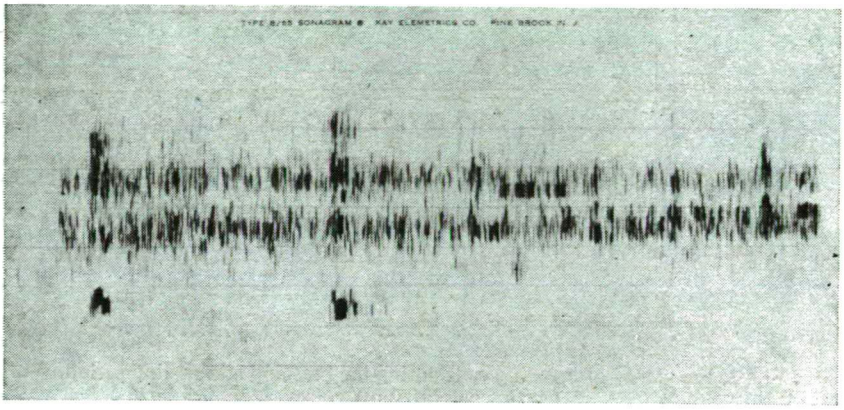
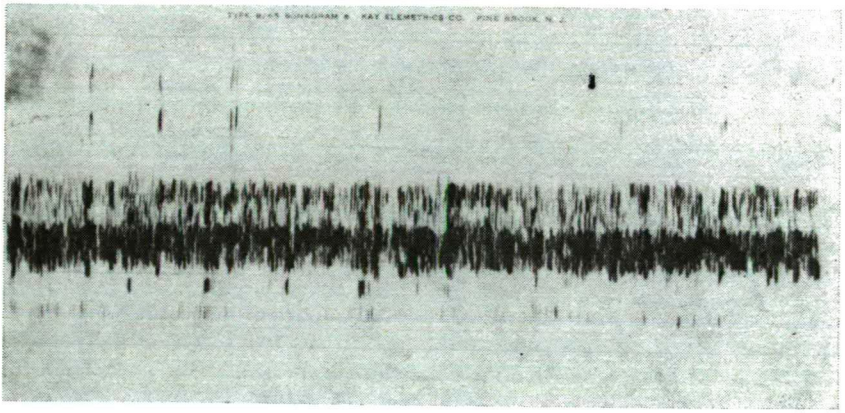


Fig. 6. Spectrogram of "quark" call.



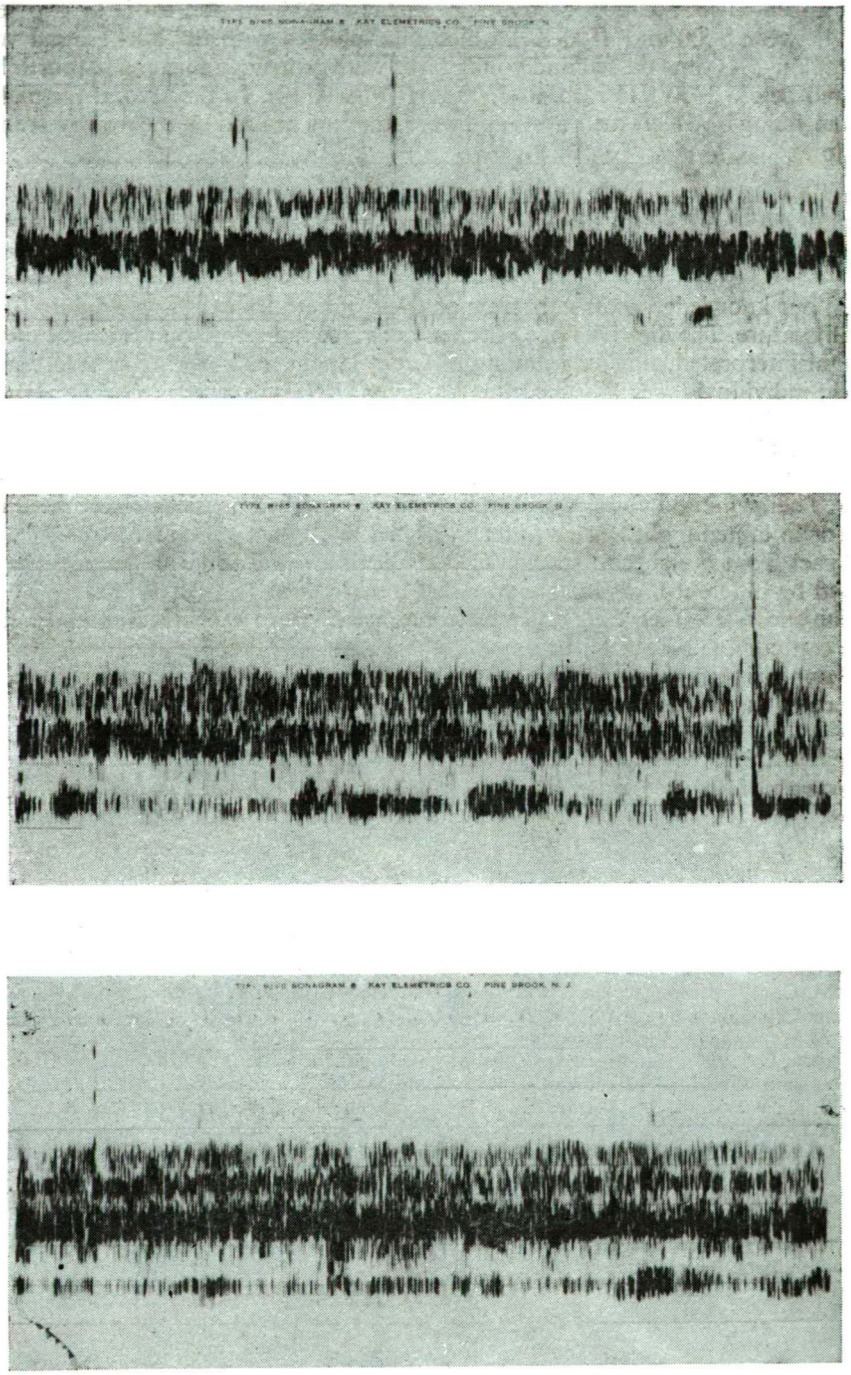


Fig. 7. 8. 9. 10. Spectrograms of nestling voices recorded successively on V. 28, VI. 4, VI. 10 and VI.17, 1978.

voices appeared first at 5000—8000 KH on the sonogram and more in two broad bands between 2000 and 4500 KH which intermingled with the background voices of the colony. As time passed and young birds were growing a third resp. fourth band appeared below 2000 KH resp. at 3500 KH (Fig. 9, 10). In the second fortnight of June the young birds left their nests and were standing around on the nearby branches of willows.

Discussion

To our knowledge no spectrogram analysis of heronry calls appeared up to now in the literature. The disadvantage of the use of voice imitating sounds is that they are easily misinterpreted, not only among different languages speaking people but also between individuals speaking the same language (*Peterson* et. al. 1966). For example no sharp difference is audible between the calls "quark and quock" of the night heron (Fig. 4 and 6) although they can be clearly distinquished in the spectrogram, whereas the breeding call "wawawa" is very characteristic in appearance. Further some of the observed behavior and voices were until now only observed in the black crowned night heron or in tamed night herons (NIETHAMMER 1966, LORENZ 1938).

Apart from the species specific calls dialectic or individual differences are also reported by different birds in sonograms of the literature (BAKER 1975).

The successive recording and spectrogram analysis of the breeding and nestling voices can complete data on beginning of breeding or hatching and also estimation of the approximative average age of the nestlings is possible without essential disturbance of the colony.

Acknowledgement

The author is indebted to Dr. M. MARIÁN for his constant theoretical and practical help and interest.

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A labodári gémtelep bakcsó hangjainak szonogram analízise

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Kivonat

A *Nycticorax nycticorax* és *Nycticorax n. hoactli* szociális és szexuális magatartását több szerző részletesen tanulmányozta. Nem vizsgálták azonban e gémtelepek hangjait szonogram analízissel. Hangutánzó szavakkal történő leírásuk könnyen félreérthető. A faj ugyanis a specifikus hangokon kívül még tájjellegű vagy egyéni különbségeket is rögzíteni lehet szonogram analízissel (BAKER 1975). — A párképző- és fiókahangok folyamatos regisztrálása és spektrogram analízise kiegészítette a fészkelésre és a fiókák kikelésére vonatkozó, valamint a fiókák megközelítő átlagos életkorára vonatkozó adatokat, a gémtelep lényeges zavarása nélkül.

СОНОГРАММНЫЙ АНАЛИЗ ИЗДАВАЕМЫХ КВАКВОЙ ЗВУКОВ В КОЛОНИИ ЦАПЕЛЬ В ЛАБОДАРИ

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Резюме

Социальное и сексуальное поведение Nycticorax nycticorax и Nyctícorax. подробно изучено многими авторами. Однако сонограммный анализ голосов в колонии цапель ещё не имел места. Описание их с помощью звукоподражающих слов очень легко может оказаться ошибочным. В то же время с помощью сонограммного анализа (Бакер 1975 г.) кроме специфических для вида звуков мнжнв зафиксирпвать и индуальные особенности, а также и особенности, связанные с местностью нахождения. Последовательная записb звуков особей, образующих пару, и птенца и их спектрограммный анализ пополняет данные относительно закладки гнезда и появления птенцов, а также среднего возраста птенцов, не причиняя при этом существенной помехи колонии цапель.

Sonogramska analiza glasova gakova na koloniji čaplji kod Lobodár-a

WOLLEMANN MÁRIA
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Abstrakt

Više autora je detaljno istraživao socijalno i seksualno ponašanje Nycticorax nycticorax i Nycticorax n. hoactli. Medjutim nije istraživano oglašavanje kolonije čaplji sonogramom. Opisi glasovnih oponašanja su često pogrešno shvaćeni. Pomoću sonograma moguće je analizirati osim specifičnih glasovnih svojstava vrste još i individualne i lokalne razlike (BAKER 1975). — Neprekidno registrovanje i spektrogramska analiza dopunaila je podatke u odnosu na period gneždjenja i pilenja, a takodje omogućuje i približno odredjivanje uzrasta mladunaca bez znatnijeg uznemiravanja kolonije.

Tiscia (Szeged) Vol. XV, pp. 139—149 (1980)

FROM THE LIFE OF THE TISZA-RESEARCH WORKING COMMITTEE TISZA-RESEARCH CONFERENCE XI(1980)

Compiled by

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General investigations conducted iu the river-system of the Tisza

ANDÓ, M.:
Major geographical problems in the Tisza river-system

The lesson affords the physical geographical evaluation of the river-basin of the Tisza. The physical geographical factors, affecting the prevailing changes in the water-circulation, taking place in the Tisza river-system, are analysed as efficiency factors. We have taken into consideration the relief situation of the terrain, as well as the connection with the downflow situation. The downflow relations were cleaned in the interaction of relief and climate, as well. The joint effect of the degree of efficiency of artificial interventions and of the connections of natural factors, exerted on the motion relations and changes of the state of surface waters, was also evaluated. We have examined the whole of the Tisza river-system, following the order of magnitude of the side-watershed areas. In this way, it is possible to give evaluating statements concerning the formation of the water quantity of the Tisza, after recognizing the regional differences.

Investigations conducted in the longitudinal sectjon of the Tisza in 1979

FEKETE, E., K. FÜGEDI, KLÁRA:
Investigation into the samples of Tisza water and bottom sediement in 1979

The heavy-metal content of the river-water and bottom sediment was investigated in almost the whole Tisza stretch in Hungary (from Dombrád till Szentes).

On the basis of the data measured at fifteen characteristic sampling sites, conclusion can be drawn concerning the polluting sources (vine-producing area at Tokaj-Hegyalja: copper; Sajó river: mercury, cadmium, chromium; Zagyva river: zinc, copper; Dongér; mercury, cadmium, chromium).

These data serve as a basis for the investigations, which should be conducted in greater detail and more serviceably in the future, in order to be able to solve with

success the highest aim of the nature conservation of the environment, viz. prevention.

The lecture summarizes the investigational results of the first year of the gauging work of several years and indicates the activity of the following years.

K. FÜGEDI, KLÁRA:

Foreign (anti-environment) organic matters, affecting water quality in the lower Tisza region

We have investigated for five years into the formation of the four organic compound groups, to be measured in the water of the Tisza.

These compounds have got into the water in the course of human activity, i.e. they are foreign materials for our environment.

We have taken the samples from the Lower Tisza reaches, from Csongrád till the Hungarian Jugoslav border, from more than 80 km reaches. This has meant yearly 60 samples.

We have established concerning the formation of the concentration of (UV oil-mineral oil) derivatives, extractable with carbon tetrachloride, that going down the river, an increased pollution may be observed.

As the living condition of the man improved, a new matter appeared in his environment: the large family of tensides. In a 5-year average, the comparatively low detergent concentration is characteristic.

The phenol content is low from Csongrád till Szentes, comparatively high downwards from Szentes. This phenomenon may also originate from that during the last ten years several thermal-wells were bored, the outflow water of which got indirectly into the Tisza.

HEGEDŰS, MÁRIA and ZSIGÓ, MARGIT:

Bacteriological investigations in the sediment of the longitudinal section of the Tisza

(Results of the investigation into the *Clostridium* number)

In the microbiological laboratory of the Station of Public Hygiene and Epidemics of County Csongrád, we have carried out the determination of *Clostridium* number — in the organization of the National Water Office and the Water Conservancy of the Middle-Tisza Region — from the samples of the Tisza longitudinal section and the major tributaries.

On the basis of the results of investigation, the following are to be established:

1. On the basis of the change in size of results, the sediment of the Tisza is unexceptionable, respectively, in the lower reaches, it is a little polluted.
2. The quality of sediment of the Maros river is the most unfavourable, it is, namely, medium polluted.
3. On the basis of the change in size of values — similarly to the change in water quality, registered on the basis of the content of floating matter — we may distinguish between the sediments of character of the Upper-, Middle- and Lower-Tisza reaches.

ESTÓK, B.:

Results of the sediment investigations, conducted in the longitudinal section of the Tisza and in the major tributaries. Investigation into faecal indicator bacteria

In the longitudinal section of the Tisza, from riv. km 689 till riv. km 172, as well as in the mouth of tributaries, we have conducted sediment-bacteriological investigations at 76 sampling sites, determining the *Coliform,* Faecal coliform and Faecal streptococcus numbers of samples in MPN value, relating to 1 g wet sediment.

It turned out in the course of investigations that from among the tributaries of the Tisza, the sediments of the Bodrog, the Sajó and the Zagyva were the most polluted. There can be demonstrated important differences between the right- and left-side sections, as a result of sewer pipes, as well as of the streaming relations of rivers.

At present, the Tisza is still able to decrease the bacteriological pollution of tributaries with its self-purificating process.

It has been proved that in the bottom sediment of the surface waters, loaded by sewage waters, the bacteria indicating faecal pollution are present in a considerably higher number than in the water itself. Consequently, the probability of the presence of enteral pathogenic bacteria is higher, as well.

MRS. L. DOBLER—KOVÁCS, KATALIN:

Investigation into the sediment of the Tisza, with particular regard to diatoms

In the course of the investigation, we have emphasized two problems: on the one hand, we have identified the diatoms of the algal association of the bottom sediment; on the other hand, we have given the number-value of them, falling on 1 sq.cm surface. (The algal count was carried out with a microscope of reversed system).

From the diatoms living in the Tisza benthos, we have identified 164 species, which represented 29 taxa.

† JÓSA, Z.:

Investigation into the Ciliata fauna of the sediment samples taken from the reaches of the Tisza in Hungary

I have identified 80 Ciliata species in the course of the investigation. The observation of live animals was carried out with microtechnical procedure. It is to be established that the Ciliata substances of the sediment samples taken from the Tisza are comparatively rich both in respect of species and individual numbers.

The most frequent and wide-spread Ciliata species are: *Cyclidium libellus, citrullus, obliquum, Cinetochilum margaritaceum.* The frequent appearance of *Coleps hirtus* in large numbers is striking. In the sediment samples — in contradiction to the plankton investigations — there were found a few very small (16—20 μ) Ciliata species, as well. Most species are sapropel-, i.e. sediment-, detritus-dwellers.

GÁL, D., BANCSI, I. and ZSUGA, KATALIN:

The Testacea, Rotatoria and Entomostraca fauna of the sediment samples of the longitudinal-section investigation in the Tisza

In the reaches of the Tisza in Hungary and in the mouth of its tributaries between 2 August and 15 September, 1979, we conducted the investigation of the Testacea Rotatoria and Entomostraca fauna of the 76 sediment samples collected in 36 sections.

TESTACEA: There were found 39 Testacea species. Both the species and the individual numbers were generally very low. *Centropyxis aculeata* STEIN, *Arcella vulgaris* EHRB. and *Arcella rotunda* v. *aplanata* DELF. are the most frequent and they generally occurred in the highest individual number. The tributaries don't generally make any essential effect on the Testacea fauna of the Tisza sediment.

Rotatoria: We have demonstrated 13 Rotatoria taxa. From amoung these four species proved to be new in the fauna of the Tisza. These are: *Encentrum wiszniewski* WULFERT, *Notommata cyrfopus* GOSSE, *Philodina citrina* EHRB., *Philodina roseola* EHRB. The population of the species found is very sparse.

Entomostraca: These lived at only few sampling sites and in low individual number. Two *Cladocera* species were found, both from the right-side silt of the Zagyva. Copepoda taxon could also be found in not more than four places. In a fully developed form two species occurred. Ostracoda could only be found at two sampling sites and here, as well, only void shells.

FERENCZ, MAGDOLNA and SZITÓ, A.:

Zoobenthos investigation in the longitudinal section of the Tisza

The dominant fauna-elements of the zoobenthos in the Tisza are Oligochaetes. The quantitative distribution of the 3572 individuals of the 22 species is uneven: it varies between 4—1164 ind./sq.m. These worms reached the maximum of their individual density in the reaches of the Tisza below the mouth of the Maros, resp. in the Lónyai Canal. The Oligochaeta-fauna of the Sajó, Szamos and Maros is sparse, similarly to a few sampling sites in the Tisza, particularly in the Upper-Tisza region.

The tendency of decrase in the individual number could generally be observed at the sampling sites below the inflow of tributaries.

71 per cent of the Oligochaete fauna was formed by the individuals of „a", resp. „a—p" species.

17 individuals of *Hypania invalida,* falling within the Polychaete class, were found in the Lower-Tisza Region (between the mouth of the Körös and Szeged).

In the Upper-Tisza — till the mouth of the Bodrog — Chironomidae (*Sphaeromias* sp., *Demicryptochironomus* sp.) were found, which are euryecious against the effects of the environment and can be found in standing waters, as well. In the reaches above the Lónyai canal, however, a Chrironomid species lives, which is extremely characteristic of standing waters. In the retained reaches of slow flowing or in the slown-down waters in the environment of Szeged, the *Polypedilum nubeculosum, Chironomus plumosus* and the rapacious *Cryptochironomus* species are characteristic. The development of the latter in large numbers can be brought into connection with the high Oligochaete individual density to be found in these reaches.

B. TÓTH, MÁRIA and BÁBA, K.:

The Mollusca fauna in the bed of the Tisza and its tributaries

On the basis of 11 samples, each collected in the Tisza and tributaries, in 99 cross-sections from border till border with a grab-dredger, the following is to be astablished.

The most individuals of the eight shall-fish and three snail species are found in the samples close to the right and left sides, in harmony with earlier establishments (BÁBA, 1974, 1977). The larger part of Mollusca prefers clayey mud *(Valvata piscinalis, Lithoglyphus, Pseudanodonta, Pisidium amnicum)*. On sandy sediments *Unio crassus, U. tumidus, Dreissena* sp., on soft mud *U. Pictorum* were more frequent.

Most species and individuals were found in the reaches between Bodrog—Sajó and Zagyva—Maros. The poverty in Mollusca fauna in the Upper-Tisza till the Lónyai canal and in the Kisköre Reservoir is striking. In the years between 1963 and 1971, in contradiction to the greatest observed individual density 666 A/sq.m (BÁBA 1974), only in one place occurred 486 A/sq.m. The average observed individual density fluctuated between 3,5—100 A/sq.m. The results refer to a more considerable pollution.

BANCSI, I.:

Experiences of the sediment-investigations in the Tisza in 1979

In conformity with the instructions obtained from the Department of Environmental Protection of the National Water Office, the Water Conservancy of the Middle-Tisza Region — co-operating with the Tisza-Research Working Committee — conducted a longitudinal-section investigation in the Hungarian reaches of the Tisza. The aim of research was to analyse the sediment of the Tisza and tributaries physically, chemically and biologically.

In accordance with the expectations of the committer, the experts of fourteen institutes have taken part in the work.

The canalization of the Tisza, the increase in its load with polluting matters, are at present not yet connected with a change of so high degree, which would considerably limit the use of water. The investigations into the sediment cast, however, light upon the direction of change and the consequences to be expected.

The accumulation of organic matters and vegetable nutriments in the sediment brings with itself periodically the development of anaerobic conditions, which will not leave unchanged the present-day water quality, either. The change in the botanical living world, the decrease in the number of the rather sensitive species, the prevalence of the euryecious beings are showing the future, which is to be expected as a consequence of the current tendency and cannot at all be considered as favourable. By enforcing the principles of regulating water quality and at a continuous supervision, however, the present-day state can be preserved and possibly even improved.

KISS, I.:

Algological and hydrological investigations in the tributaries of the Upper-Tisza Region and their environment in Hungary

In the Summer of 1979, from among the tributaries of the Tisza, the Bódva, the Hernád with the Szártos-brook, and the Kraszna were investigated. At the railway station at Szendrő, the Bódva is of considerable fall, of rapid flowing; below the village, however, it is of slower flowing and its eutrophication can also be observed. From the previous place nine, from the latter sixteen algal species could be demonstrated. The Hernád at Hidasnémeti is also at the beginning of eutrophication, mainly owing to the pollution of the surrouding areas. Its right-side tributary is the Szártos-brook, loading the Hernád with much alluvial soil. The water of the Szártos is densely silty stinky, of polysaprobic character. The mostly still water of one of the inundations close to the riverside, was stained greenish blue by the mass production of *Anabaena spiroides,* and some of their trichomata were cut to planococcus cells. The cell-heaps, coming into being in this way, were very similar to the colonies of *Mycrocystis.* This phenomenon also shows the considerable lack of air in water. In the Hernád, 12 algal species were found. At Nagyecsed, the Kraszna has also been more and more eutrophicated. From its water, fourteen algal species could be demonstrated.

HAMAR, J. and BORBÉLY, GY.:

Estimation of the heterotrophic production in the sediment of the Tisza and its triabruites

The method is based on the incorporation of inorganic ^{14}C, supposing that with this method we shall get an answer to the in greatest part heterotrophic bacterial activity. 1) In the interest of the efficiency of the method, several methodical problems were to be cleared. 2) The oxygen requirement, which is proportional to the incorporation of carbon, is of similar value to the biological oxygen requirements measured in the Tisza. 3) The ^{14}C incorporation is unambiguously the result of biological activity. 4) The heterotrophic (bacterial) activity of the sediment is about one hundredfold — maximum one thousandfold — the activity of the water lying above it. This means that the capacity of the sediment of decomposing organic matters — and together with this its oxygen consumption — are very considerable. 5) The absolute values of the heterotrophic production of the sediment show a positive correlation with the values of the chemical oxygen requirement ($COR_s Mn$). On the basis of this, the Lónyai canal, the Zagyva and the canal at Csany-fok are most polluted, resp. loaded with organic matter. These are followed by the dammed Kisköre reaches and the Körös; the others are of nearly similar value. 6) Literary data and our own results refer to that the heterotrophic activity of the sediment is a function of the organic-matter load and temperature.

OBRADOVIĆ, MELANIJA:

Rare plants along the Tisza

In our paper we are dealing with thirteen autochthonous and two neophytic plants in the investigated floral area. These are: four postglacial relicta (*Bulbocodium verum* L., *Strenbergia colchicifora* W. K., *Scilla autumnalis* L. and *Crocus variegatus* HOPPE et GORNCH), two Pannonian endemic plants (*Rhinanthus borbasii* (DÖRFL.) SOÓ and *Dianthus giganteiformis* (BORB.) SOÓ .In the group of rare plants, *Allium atroviolaceum* BOISS., *Spiranthes spiralis* (L.) K. KOCH., *Blackstonia perfoliata* (L.) HUDS., *Iris pumila* L., *Lotus siliquosus* L., *Hordeum asperum* (SIMK.) DEG and *Rhinanthus rumelicus* VELEN occur. We have elaborated two neophytes, as well: *Commelina communis* L. and *Lepidium virginicum* L.

We have analysed the plants, mentioned above, from chronological, phytogeographical and ecological points of view and specified their area in the flora along the Tisza.

BODROGKÖZY, GY.:

Shading effect of Populus groups on the species components and environment-ecological relations of marshland associations. II

The clusters of trees *Populus alba,* developed in the island Körtvélyes, depending on the points of the compass, overshadow the stocks *Lythro-Alopecuretum, Carici-Alopecuretum,* resp. *Caricetum gracilis* in their environment in different degrees. To the impact of these differences, presenting themselves in respect of light intensity, the species components of the simple associations responded in different degrees in 1979, as well. In the stretches facing north and west, exposed to the most intensive shade effect, *Glycyrrhisa echinata,* considered as most intensively photophilic, responded further on most intensively; *Lythrum salicaria* and *L. virgatum* did this to a lesser extent. They were replaced by *Alopecurus pratensis.*

From the point of view of habitat-ecology, a rather considerable difference in the field of being supplied with moisture presented itself. The soil of meadow associations, taking place in southern direction from the cluster of trees, was found driest; after this, that of the stock lying east of the cluster. The coenoses, investigated northwards, resp. westwards, showed lesser differences in respect of moisture. The most important differences could be demonstrated at the end of the growing season, when the flood impact on the early Summer no more prevailed.

KOZMA, A. and TÖLGYESI, GY.:

Investigation into the plant associations of the Tisza after passing of the spring flood-wave in the flood plain at Abádszalók in 1979

In the Spring of 1979, a flood-wave reaching the record height so far, passed down the Tisza. Simultaneously with building the Kisköre Reservoir, and even after that, considerable works of flood prevention were carried out at the Abádszalók site, as a result of which the flood-wave does not inundated the inundation area. By

building the about 2 m deep water conduit, running in the middle of the inundation area, the forest district in the inundation area decreased and the area of hayfield and grassland increased. In the course of our investigations we have established that — as a result of the vigorous human intervention — the fundamental plant associations, described above, survived in the inundation area but, considerable areal displacements followed (decrease in forest associations, increase in grassy associations). We have observed remarkable quantitative and qualitative changes in the vegetable composers of certain plant associations, as well. From all these, the conclusion can be drawn that as a result of the secure river-side and flood-prevention, the agricultural use of a larger area of the flood plain becomes possible. We have collected 41 plant species from the flood plain. The chemical investigation into plant samples and the soil of flood plain is in process in respect of their content of macro- and micro-elements.

KISS KEVE, T.:

The connection between certain properties of water and plankton algae in the Eastern Main Channel

From the investigational material of water samples, taken between 1968 and 1975, from the Eastern Main Channel at Tiszalök, Tiszavasvári, Balmazújváros, I am comparing a few series of data, which may directly be connected with one another, resp. with the quantitative conditions of algae. I have made Bravais's correlation-calculation from the series of data of water output, floating-matter content, translucence $1/\beta$, chemical oxygen requirement, alga number. The comparison concerning water outputs was only possible at Tiszalök.

The values of correlation coefficient are the following:

	Tiszalök	Tiszavasvári	Balmazújváros
Water output			
floating matter	0,6893		
chemical oxygen requirement	0,4021		
alga number	0,4304		
$1/\beta$	0,8260		
$1/\beta$			
alga number	0,5535	0,5793	0,4889 (Summer-Autumn)
			0,5893 (early Spring)
Floating matter			
chemical oxygen requirement	0,7076	0,6849	0,2882
alga number	0,7010	0,6207	0,3996
translucence	0,7451	0,8107	0,8129
Floating matter			
$1/\beta$	0,8790 (a value calculated on the basis of common data of the three sampling sites)		
Alga number			
chemical oxygen requirement	0,0084	0,1106	0,3077

FARKAS, Á.:

Role of rapacious fishes in the fish fauna of the Tisza Dead-Arm at Körtvélyes

In October, 1979, at fishing out the dead-arm, I have evaluated on several occasions the quantity of the rapacious fishes caught out.

17 per cent of the total weight of fishes caught out were rapacious fishes.

12 per cent *Esox lucius*

3 per cent Perca fluviatilis

2 per cent

Silurus glanis
Lota lota
Amiurus nebulosus

Particularly the well-nourished state of the individuals fished out was striking. For instance, the weight of atri-annual pike, having roe was 1200 g, that of a pike of the same age 700—750 g.

The good tempo of growing can be explained by the specific situation of the dead-arm and, consequently, by the fauna oft he fish.

The dead-arm is inundated by the Tisza more than once in a year. The first considera bleflood-wave generally comes in March. This conincides with the spawning of pike and the brood of pike, hatched out in the waters at the river-side finds plenty of plankton. The young brood, getting back with the receding of water, begins to follow a predatory course in life. The hatching period of Cyprinidae *(Abramis brama, Rutilus rutilus, Alburnus alburnus)* coincides just with this. These ensure the conditions of nutrition to rapacious fishes for the whole year.

The aquatic vegetation of the dead-arm means a good hiding-place for the pike. And the mollusks, insects, living on the vegetation, give food to Cyprinidae.

LEGÁNY, A.:

Comparative ornithological investigation into the flood-plain meadow at Tiszalök and Rakamaz

The paper performs the comparative analysis of the avifauna of the flood-plain meadows at Rakamaz and Tiszalök. In the course of systematical stock-takings, the author has established the number of nesting species and pairs, as well as their distribution in each nesting biotope. On the basis of these and the analysis of the observed ecological changes, he has established the following:

1) As a result of the human environment-forming activity — pasturing, mowing, reforestation of grasslands and water-regulation — the original autochthonous biocoenosis grows poor, its species composition changes, and this may be observed in case of bird communities, as well.

2) As a consequence of reforestation, in the meadow certain bird species settle down, which are foreign from the ecosystem — mainly arboricolous and dendricolous species.

3) In the flood plain of the Tisza, there are still some ecosystems which preserved comparatively much of their original feature and living world. The flood-plain meadow at Rakamaz is like this, as well.

4) The areas, where the ancient state can be recognized, even if with more or less changes, should be placed under protection. The declaration that the flood-plain meadow at Rakamaz should be protected, is therefore entirely justified, connecting it to the Region Conservation District, to be created in the future.

MOLNÁR, GY.:
Investigation into the nest colonies and nesting conduct of the starling *(Sturnus vulgaris)* in the flood plain of the Tisza

One of the species of the largest population of birds, hatching in the flood plain of the Tisza, is the starling. Its role is much debated, particularly in economic relation. Their nest colonies are very considerable in the ecosystem of the flood plain. The colonies develop in the sections rich in hollows of the willow-plantations. The individuals of the nesting stock acquire their food from the adjacent agricultural areas. This movement of birds could be weel followed with attention from the dam. It was possible, to count the individuals and to conclude from this the number of nesting dairs. Sparrows bring in their bills together more than one insect to their nestlings. Their feeding rhythm is fast. They have two hatchings every year. Thus, they destroy an enormous quantity of insects during the feeding periods. Their customs, the forms of their conduct, observed in the nesting period, contain particular elements, as well, which cannot be seen at other wirbler species.

MIKES, M., VESNA, H. and SRDJA, D.:
Alimentary biology of the wild-cat

The authors have investigated into the alimentary biology of the wild-cat *(Felis silvestris* SCHR.*)* as a function of the space requirement (area of activity and the ray of the district of movement) of the carnivore and prey. It turned out from the investigation into the gastric content of 43 individuals, originating from the flood-plain forests of the Tisza that the prey of the wild-cat consists, in cca 90 per cent, of small mammals. About 63 per cent of this food quantity consists of field mice *(Microtus arvalis)*.

The close interaction, existing in the given biotopes, in which the single small mammalian races — mainly owing to their alimentation requirements — become specialized, refers to that this rapacious species exerts an important effect on the population of the single rodent species within the given ecotone.

CSIZMAZIA, GY.:
Demecological investigation into the populations of the ondatra *((Ondatra Zibethica)* in the Tisza valley

In the structure-elements of the populations of this mammalian species, naturalized or introduced into our home fauna, considerable changes ensued in the past decades. The comparison of the results of investigations, conducted in the various Tisza-valley biotopes recently, referred to the evolutional changes in the structural elements, of Ondatra populations. Among the data of the structural elements, there are some with such signs and tendencies, which can intensively affect

the economic and other manipulative activity of man, as well (river barrages, canalizations and irrigation plants, etc.), in a negative way.

We have received well-registrable data concerning the genital and physical conditions of the population, the spacial distributionof it, how it behaves and multiplies.

We have carried out the more years long population-dynamical analysation of the structure-elements, which can be brought into connection with the environmental changes, taking place in the biotopes. Certain part figures of the demecological investigations give us indications of nature- and environment-conservation, as well.

CSOKNYA, MÁRIA and HALASY, KATALIN:

The effect of changes in salt concentration on special cell groups of the branchia of cloeon dipterum (L.) (Ephemeroptera)

The larvae of Cloeon dipterum occur in waters of very different salt content, as well and can survive even a considerable change in salt content. This raises the possibility that they have a mechanism which serves for protect them from the change.

On the whole body surface of larvae, but particularly on their brachiae, peculiar cells, resp. cell groups occur, which can perform NaCl-adsorption. It is proved by various adaptation experiments that the number of these cells is affected by the salt content of the outer medium.

In case of an increasing salt concentration, the number of these cells decreases, and just the other way round. The cells, on the basis of their capacity of NaCl adsorption, are presumably parts of a regulating mechanism, i.e., they are osmoregulative organs.

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REPORT OF THE ACTIVITY OF THE TISZA-RESEARCH WORKING COMMITTEE IN 1979

M. MARIÁN
Tisza-Research Working Committee, Szeged

The work of the Tisza-Research Working Committee was carried out in 1979 — the 22nd year of its existence — in the framework of the subject, sponsored by the Hungarian Academy of Scienes, entitled Complex research into the flood plain of the Tisza, with regard to the river barrages and nature reserves, connected with the international programme "Man and Biosphere", within the partial task, entitled "2,3: Research into the water ecosystem", of the main direction of the Hungarian Academy of Sciences, entitled: "Protection of the man and his natural environment (biosphere)".

Owing to the death of the late Prof. Dr. IMRE HORVÁTH, president of the Tisza-Research Working Committee, our collective has sufferred a great loss. He was an excellent organizer, an extremely work-loving, always helpful leader. During his activity for nearly a decade, he did not only intensify and extend the Tisza-Research work but also led it on, with success, to the international field.

I. General investigations carried out in the water system of the Tisza

The relations of downflow were cleared up in the interaction of the configurations of the terrain and climate, as well as the investigation into the joint effect of artificial interventions and natural factors on the kinetic relations of surface waters. The whole Tisza water system was taken into consideration, in the order of magnitude of the side-catchment areas. In this way, evaluating statements can be given about the formation of the water quantity of the Tisza.

II. Investigations carried out, in the longitudinal section of the Tisza

Being commissioned by the National Water Office, the Water Conservancy of the Middle Tisza Region, together with the Tisza-Research Working Committee, carried out an investigation into the longitudinal section of all the Tisza reaches in Hungary. The aim of the investigation was to analyse the sediment of the Tisza and its tributaries physically, chemically and biologically.

In the work, the experts of 14 institutes participated. In addition to the laboratories of the Water Conservancies of the seven Tisza Regions, testing water materials, the co-operation of the co-workers of the Station of Public Hygiene and Epidemics of County Heves, the Biological Research Centre of the Hungarian Academy of Sciences in Szeged, the Teachers' Training College in Szeged, the Scientific Research Institute of Water Management and Research Institute of Fish Husbandry in Szarvas enabled to carry out the investigation in a duly wide range.

The canalization of the Tisza, the increase in loading it with polluting matters, are at present not connected, as yet, with a change of so high degree, which would restrict the use of water considerably. The investigations into the sediment, however, cast light upon the direction of change and the consequences to be expected.

The accumulation of organic matters and vegetable nutritive materials in the sediment periodically induce the development of anaerobe conditions, which will not leave the present water quality unchanged, either. The change in zoobenthos, the decrease in number of the rather sensitive species, the prevailing of the euryecious ones indicate the future to be expected, which cannot be considered as something favourable. Implementing the principles of regulating water quality and in case of a continuous supervision, at any rate, the present-day state can be retained and, possibly, even improved.

III. Investigations performed in different Tisza reaches and nature reserves

In the course of algological investigations, in this year from among the tributaries of the Tisza: the Bódva, the Hernád with the brook Szártos and the Kraszna have been analyzed.

In the flood plain of the Jugoslav reaches of the Tisza, the investigations have demonstrated several plant species of rare presence.

The tree-groups Populus alba, developed on the Körtvélyes island, overshadow the marsh-meadow associations of their environment, in different degrees, depending upon the points of the compass. It has been demonstrated by the investigations in detail that, as a result of the different light intensities, the species components of the single associations respond in different degrees.

The plant associations of the flood plain of the Tisza were investigated in the area of Abádszalók after the passing of the flood-wave of record height in the Spring of 1979. It has been established that — as a result of the vigorous human intervention — the fundamental plant associations have survived in the flood plain but essential areal displacements followed.

A considerable proportion of the stock of fish in the Tisza dead arm (17 per cent of the total weight of fishes, fished up from the Tisza) were predatory fishes. The rapid breeding of these species may be explained by the fortunate sequence of the passing floods and the spawning-season of fishes.

As a result of the environment-forming activity of man, the original meadow-biocoenosis at the Tisza has changed, grown poor. This phenomenon can be observed at the bird-communities of the meadow, as well. In the flood plain of the Tisza, however, there are to be found some meadows, resp. ecosystems, which have preserved comparatively much of the aspect of their original avifauna. The flood-plain meadow at Rakamaz is also like this. It would, therefore, be justified, to place it under nature conservation.

After investigating into the alimentation-biology of wild cat (Felis silvestris), living in the flood plain of the Tisza reaches in Jugoslavia, it was established that this rapacious species has an important influence on the population of the single rodent species within the given ecotones.

The comparison of the investigations, carried out recently in various biotopes in the Tisza-valley, drew the attention to the evolutionary changes in the structural elements of the ondatra (Ondatra zibethica) populations. Among the data of the structure elements there are some that may exert a negative influence on the human economic activity. It is, therefore, advisable to take these into consideration at planning and building the establishments of water conservancy.

In the XIth Tisza-Research Conference, held in Szeged in April, 32 of our co-workers rendered account, in 28 lectures, of the results of investigations. The lectures were discussed by the participants in more than 80 contributions. Our colleagues from Jugoslavia have also participated actively in the Conference.

Further 35 lectures were delivered about the results of the Tisza-Research work by 22 of our co-workers in 10 towns, at 10 different instances.

The results of researches in the last ten years were primarily recorded by the TISCIA, a periodical journal of the Tisza-Research. Its last volume XIV contains 21 papers. Further 12 papers and other articles were published in other scientific and popularizing journals.

The Tisza Research was carried out in unpaid voluntary work by 44 researchers from Hungary and five from abroad. (The professional division of the former researchers is: climatology one, water-chemistry three, hydrobiology thirteen, botany six, zoology twenty-one). The centre of research is Szeged. Co-workers live in sixteen different towns.

Last year, three co-workers of us became holders of a candidate's degree and three entered for an academic doctor's degree.

Our basic buildings at Tőserdő, Körtvélyes, our mesoclimate-measuring stations at Körtvényes, Sarud, Tiszaszöllős, our light-traps for entomologizing at Körtvélyes, our small ship „Kolokán" have served the research work with success.

Our library, containing more than 1000 volumes of valuable, special professional material, considerably enlarged this year, as well. Its development has mostly taken place by means of the international material we have received in exchange for the Tiscia. Similarly, photoarchives, our collections of sketch maps, of climatological and waterchemical data have also grown.